Министерство образования и науки России
Федеральное государственное бюджетное образовательное
учреждение высшего профессионального образования
«Казанский национальный исследовательский
технологический университет»

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HIGH ENERGY INTENSIVE MATERIALS
(Propellants, Explosives and Pyrotechnics)

PART I
EXPLOSIVES

Учебное пособие
по дисциплине «Иностранный язык»
для студентов специальности 240300 (18.05.01)
«Химическая технология энергонасыщенных материалов и изделий»

Допущено учебно-методическим объединением по образованию в области химической технологии и биотехнологии в качестве учебного пособия для студентов высших учебных заведений, обучающихся по специальности «Химическая технология энергонасыщенных материалов и изделий»

Казань
Издательство КНИТУ
2014

УДК 802(075):66
ББК 81.1

Муртазина Э.М.
High Energy Intensive Materials (Propellants, Explosives and Pyrotechnics): Part I. Explosives : *учебное пособие по дисциплине «Иностранный язык» для студентов специальности 240300 (18.05.01) «Химическая технология энергонасыщенных материалов и изделий»* / Э.М. Муртазина [и др.]; М-во образ. и науки России, Казан. нац. исслед. технол. ун-т. – Казань: Изд-во КНИТУ, 2014. – 132 с.
ISBN 978-5-7882-1574-7
ISBN 978-5-7882-1575-4 (ч. 1)

В основе учебного пособия лежит идея взаимосвязанного и одновременного развития профессиональных и коммуникативных языковых компетенций, необходимых в профессиональном общении будущих специалистов в области высокоэнергетических материалов.

Цель пособия – подвести студентов к чтению оригинальной литературы по специальности и ведению беседы на темы, предусмотренные программой языковой подготовки третьего поколения. Пособие рассчитано на аудиторную, самостоятельную и индивидуальную работу студентов в течение I–IV семестров I-II курса, а также на магистрантскую подготовку, соответствует образовательным программам факультета энергонасыщенных материалов и изделий, сетке часов и установкам рабочих программ кафедры иностранных языков в профессиональной коммуникации КНИТУ.

Печатается по решению редакционно-издательского совета Казанского национального исследовательского технологического университета

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ISBN 978-5-7882-1575-4 (ч. 1)
ISBN 978-5-7882-1574-7

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ПРЕДИСЛОВИЕ

Данное учебное пособие построено в соответствии с требованиями действующей образовательной программы третьего поколения по английскому языку для неязыковых специальностей высших учебных заведений и обеспечивает базу для достижения конечной цели обучения: формирования у будущих специалистов языковых и профессиональных компетенций в профессиональной коммуникации на английском языке. Содержание учебного пособия позволяет создать языковую среду для личностно-ориентированного и деятельностного обучения иностранному языку в профессиональной области химической технологии энергонасыщенных материалов и изделий. В первой части пособия представлены материалы по взрывчатым веществам, их свойствам и применению.

В учебном пособии использованы задания творческого и дискуссионного характера, а также задания, направленные на анализ конкретных ситуаций будущими специалистами. Это создает интерес и мотивацию при изучении иностранного языка. Профессиональный компонент и языковой компонент учебного пособия органически взаимосвязаны, а новый учебный материал детально прорабатывается в предтекстовых и послетекстовых упражнениях и закрепляется в творческих заданиях, ориентированных на решение профессиональных задач.

В основе пособия лежит концепция взаимосвязанного и одновременного развития группы речевых навыков – чтения, говорения, письма, аудирования. Такая идея в значительной степени предопределила структуру и содержание пособия.

Первая часть учебного пособия состоит из 8 уроков, каждый из которых включает три текста («A», «B», «C»). Эти тексты входят в разделы профессиональной подготовки (Professional Training) каждого из 8 уроков. Кроме того, каждый урок содержит раздел управляемого обзора пройденного материала (Guided Review). В конце пособия даны глоссарий терминов, тексты для индивидуальной работы и приложение, в которое вынесена информация об аварийных сигналах и сигналах опасности при работе с взрывчатыми веществами.

Всего пособие включает 24 текста с упражнениями. Все тексты подобраны и адаптированы из материалов, помещенных в открытом доступе в сети Интернет. Ряд текстов подготовлен специалистами и переведен с русского на английский язык.

Тематически тексты «A» носят ознакомительный характер. Тексты «B» имеют более теоретический, научный характер, они содержат терминологию предмета, которая выносится в глоссарий с более подробным комментарием. В текстах «C» содержатся менее сложные познавательные материалы, посвященные истории предмета и знаменитым деятелям науки, внесшим свой вклад в развитие высокоэнергетических материалов. На базе этих текстов отрабатываются опознание и восприятие пройденного материала и развиваются навыки различных видов чтения, а также навыки профессионального общения на иностранном языке, создается языковая среда.

Упражнения к урокам направлены на то, чтобы максимально облегчить восприятие и усвоение материала, снять языковые трудности, мотивировать и создать предпосылки для общения студентов в профессиональной сфере.

Заинтересованность студента в содержании текста и возможность высказаться по проблемам его будущей специальности входят в методический замысел уроков. Тематика текстов и множество заданий творческого и дискуссионного характера рассчитаны на то, чтобы создать дополнительный психологический стимул для занятий иностранным языком.

Учебное пособие прошло апробацию в учебном процессе кафедры иностранных языков в профессиональной коммуникации КНИТУ.

Авторы выражают глубокую благодарность рецензентам – проф. Р.А. Аюповой и проф. В.Г. Синдицкому за объективную оценку пособия и рекомендации его к изданию.

Единственное оправдание существования военной промышленности – это безопасность народа.

Альфред Нобель

Посвящается новому поколению
химиков – технологов.
Тем, кто воплощает в жизнь девиз
“Better Living through Chemistry!”

Авторы

1. Lesson One
SHORT HISTORY OF EXPLOSIVES

PROFESSIONAL TRAINING: Lesson one

Pre-text exercises to text A

1. *Read the words using transcriptions. Guess about their meanings:*

originate [q'rIGI"neIt], **exclusively** [Ik'sklHsIvlI], **suggest** [sq'Gest], **fireworks** ['fQIq"wWks], **projectiles** [prq'GektQIlz], **scholars** ['skOlqz], **arrow** ['xrqu], **charge** [CRG], **attribute** [q'trIbjHt], **discovery** [dI'skAvqrI], **medieval** ["mqdI'Jvql], **firearms** ['faIqr"Rmz], **shipment** ['SIpmqnt], **saltpeter** ["sLlt'pJtq], **suitable** ['sHtqbl]

2. *Translate the following words. Refer to the transcriptions in exercise 1 for correct pronunciation.*

происходить, исключительно, свидетельствовать о…, фейерверки, снаряды, ученые, стрела, заряд, приписывать, открытие, средневековый, огнестрельное оружие, перевозка, обычный, селитра, подходящий.

3. *Read the lexical program of text A. Try to memorize it.*

(1) Some evidence suggests…	(1) Некоторые данные свидетельствуют о…
(2) In the mid-13th century	(2) В середине 13-го века
(3) to fire an arrow	(3) запустить стрелу
(4) The English medieval scholar, Roger Bacon	(4) Английский средневековый ученый, Роджер Бэкон
(5) firearms are frequently mentioned in 14th-century manuscripts	(5) огнестрельное оружие часто упоминается в рукописях 14 века
(6) for peaceful purposes	(6) в мирных целях
(7) shipment of guns	(7) перевозка оружия
(8) came to be used	(8) стали использоваться
(9) it was widely accepted	(9) он получил широкое признание
(10) it was suitable for most mining and construction applications	(10) это подходит для большинства горнодобывающих и строительных работ

Text A. Black Powder: The First Explosive.

It may never be known with certainty who invented black powder, the first explosive. The mixture is thought to have originated in China in the 9th century, but its use there was almost exclusively in fireworks and signals. It is possible that the Chinese also used black powder in bombs for military purposes. There is a written record telling that in the mid-13th century, they put it in bamboo tubes to propel **stone projectiles**.

Some evidence suggests that the Arabs invented black powder, and by about 1300 had developed the first real gun, a bamboo tube reinforced with iron, which used a charge of black powder to fire an arrow.

Some scholars attribute the discovery of **black power** to the English medieval scholar, Roger Bacon, while others attribute the invention of firearms to the early 14th-century German monk Berthold Schwarz. In any case, **firearms** are frequently mentioned in 14th-century manuscripts from many countries, and there is a record of the shipment of guns and powder from Ghent to England in 1314.

By the 17th century, black powder came to be used in Europe for peaceful purposes, such as in mining operations in Germany and Hungary. For various reasons, such as high cost, lack of suitable boring implements, and fear of roof collapse, the use of black powder in **mining** did not spread rapidly, though it was widely accepted by 1700. The first application in **civil engineering** was in the Malpas Tunnel of the Canal du Midi in France in 1679.

For 300 years, the unvarying composition of black powder has been approximately 75 percent **saltpeter** (potassium nitrate), 15 percent charcoal, and 10 percent sulfur. Lammot du Pont, an American industrialist, started making sodium nitrate powder in 1858. It became popular in a short time because, though it did not produce as high a quality explosive as potassium nitrate, it was suitable for most mining and construction applications and was much less expensive.

Assignments to text A. 1) Make a list of early uses of black powder according to the information from text A (in writing).
2) Write out the words in black type. Give the meanings of these terms. (You may use the Glossary of Terms at the end of this book).

Pre-text Exercises to Text B.

1. Read the words using transcriptions. Guess about their meanings:

common ['kOmqn], **blasting** ['blRstIN], **laboratory** [lq'bOrqtqrI], **barge** [bRG], **abandon** [q'bxndqn], **reward** [rI'wLd], **safest** [seIfIst], **dynamite** ['daInq"maIt], **violence** ['vaIqlqns], **explode** [Ik'splqud], **obstacles** ['Obstqkqlz], **boulders** [bquldqz], **stumps** [stAmps], **loosening** ['lHsqnIN], **diamonds** ['daIqmqndz], **approximately** [q'prOksImItlI], **slabs** [slxbz], **vibration** [vaI'breISqn], **moisture** ['mOIsCq], **immense** [I'mens], **quarrying** ['kwOrIIN]

2. Translate the following words. Refer to the transcriptions in exercise 1 for correct pronunciation.

распространенный, взрывной, лаборатория, баржа, отказываться от, награда, самый безопасный, динамит, сила, взрываться, препятствия, валуны, пни, разрыхление, алмазы, приблизительно, плиты, вибрация, влага, огромный, карьер.

3. Read the lexical program of text B. Try to memorize it.

(1) explosive in common use	(1) взрывчатое вещество общего пользования
(2) practical blasting purposes	(2) практические взрывные цели
(3) Nobel was forced to move his laboratory	(3) Нобель был вынужден перевести свою лабораторию
(4) a barge anchored out in the middle of a lake	(4) баржа, поставленная на якорь на середине озера
(5) Nobel refused to abandon his labors	(5) Нобель отказался бросить свое дело
(6) he was rewarded	(6) он был вознагражден
(7) the commonest and safest	(7) самый распространенный и безопасный
(8) it will explode with great violence	(8) он взорвется с большой силой
(9)with comparative safety.	(9) сравнительно безопасно
(10) Farmers find explosives useful for breaking up boulders, blowing out stumps, felling trees, and loosening soil	(10) Фермеры находят взрывчатые вещества полезными для разрушения валунов, выкорчевывания пней, валки деревьев и рыхления почвы

Text B. Invention of Dynamite

Nitroglycerin, the most powerful explosive in common use, was discovered in 1846 by the Italian scientist Ascanio Sobrero. Although used as a headache remedy under the name glonoin, it proved too difficult and dangerous for practical blasting purposes until Alfred Nobel of Sweden began his experiments in 1862. Nobel's brother died in an explosion during the tests, and Nobel was forced to move his laboratory to a barge anchored out in the middle of a lake. Nobel refused to abandon his labors, however, and in 1866, he was rewarded by the invention of dynamite. This is today the commonest and safest of the high explosives, for the first time enabling man to blast away great masses of rock and other obstacles with comparative **safety**.

Dynamite consists of a mixture of the liquid nitroglycerin with some absorbent substance, or "dope," giving it a solid form. Ordinary dynamite is usually made in sticks from 1 to 2 inches (2.5 to 5 centimeters) in diameter and about 8 inches (20 centimeters) long. These consist of brown paper wrappers coated with paraffin to keep out moisture. If a small quantity is set on fire free from pressure or vibration of any kind, it will burn, but, if the least blow strikes it while burning, it will explode with great violence. Dynamite is usually set off with a **detonator**, or **blasting cap**.

Destructive in nature, explosives are also of immense value in many peaceful pursuits, such as in mining, quarrying, and engineering enterprises and in making fireworks, signal lights, and rockets. They are used to project lifelines to ships in distress off storm-beaten shores or to the roofs of burning buildings; to cast oil upon rough seas; and to break up ice jams. Farmers find explosives useful for breaking up boulders, blowing out stumps, felling trees, and loosening soil.

Explosives are sometimes used to bond various metals to each other. For example, when silver was removed from United States coinage, much of the so-called sandwich metal that replaced it was obtained by the **explosive bonding** of large slabs, which were then rolled down to the required thickness. These slabs are placed parallel to each other and approximately 0.25 inch (6.4 millimeters) apart. An explosive developed especially for the purpose is placed on the top slab, and its detonation slams the slabs together with such force that they become welded. **Stainless steel** is often joined to ordinary steel in this manner. Finally, the very fine industrial-type diamonds used for grinding and polishing are produced by the carefully controlled action of explosives on carbon.

Assignments to text B:

1) Make a list of uses of black powder according to the information from text A (in writing).

2) Write out the words in black type. Give the meanings of these terms. (You may use the Glossary of Terms at the end of this book).

Pre-text Exercises to Text C.

1. Read the words using transcriptions. Guess about their meanings:

manufacturer ["mxnju'fxkCqrq], **armament** ['Rmqmqnt], **previous** ['prJvIqs], **primarily** ['praImqrIlI], **patent** ['pxtqnt], **will** [wIl], **posthumously** ['pOstjumqslI], **fortune** ['fLCqn], **synthetic** [sIn'TetIk], **survive** [sq'vaIv], **childhood** ['CaIldhud], **nobelium** [nqu'bJlIqm], **impoverish** [Im'pOvqrIS], **descendant** [dI'sendqnt], **Swedish** ['swJdIS], **scientist** ['saIqntIst], **engineering** ["enGI'nIqrIN], **nitroglycerin** ["naItrqu'glIsq"rJn], **diatomaceous** ["daIqtq'meISqs], **nitrocellulose** ["naItrqu'selju"lqus], **potassium nitrate** [pq'txsIqm'naItreIt], **Gelignite** ['GelIg"naIt], **financial** [faI'nxnSql], **success** [sqk'ses]

2. Translate the following words. Refer to the transcriptions in exercise 1 for correct pronunciation.

производитель, оружие, предшествующий, первоначально, патент, завещание, посмертно, состояние, синтетический, выжить, детство, нобелий, обеднеть, потомок, шведский, ученый, инженерное дело, нитроглицерин, диатомовые, нитроцеллюлоза, азотнокислый калий, гелигнит, финансовый, успех,

3. Read the lexical program of text B. Try to memorize it.

(1) a Swedish chemist, engineer, innovator, and armament manufacturer	(1) Шведский химик, инженер, рационализатор и производитель оружия
(2) in modern-day companies	(2) в современных компаниях
(3) it became safer and more convenient to handle	(3) стало безопаснее и удобнее в обращении
(4) a more efficient recipe	(4) более эффективный рецепт
(5) a host of similar combinations	(5) множество подобных комбинаций

окончание таблицы

(6) modified by the addition of potassium nitrate	(6)модифицирован добавлением нитрата калия
(7) though at a significant cost to his health	(7) хотя и со значительными затратами для здоровья
(8) ballistite, the precursor of many modern smokeless powder explosives	(8)баллистит, предшественник многих современных взрывчатых веществ бездымного пороха

Text C. Alfred Bernhard Nobel – the Inventor of Dynamite.

Alfred Bernhard Nobel (21 October 1933 – 10 December 1896) was a Swedish chemist, engineer, innovator, and armament manufacturer. He was the inventor of dynamite. Nobel also owned ***Bofors***, which he had redirected from its previous role as primarily an iron and steel producer to a major manufacturer of cannon and other armaments.

Nobel held 350 different patents, dynamite being the most famous. His fortune was used to posthumously institute the Nobel Prizes in accordance to his will. The synthetic element nobelium was named after him. His name also survives in modern-day companies as ***Dunamite Nobel*** and ***AkzoNobel***, which are descendants of the companies Nobel himself established.

Born in Stockholm, Alfred Nobel was the fourth son of Immanuel Nobel (1801–1872), an inventor and engineer, and Karolina Andriette (Ahlsell) Nobel (1805–1889).The couple married in 1827 and had eight children. The family was impoverished, and only Alfred and his three brothers survived past childhood. Through his father, Alfred Nobel was a descendant of the Swedish scientist Olaus Rudbeck (1630–1702),and in his turn the boy was interested in engineering, particularly explosives, learning the basic principles from his father at a young age.

Nobel found that when nitroglycerin was incorporated in an absorbent inert substance like *kieselguhr* (diatomaceous earth) it became safer and more convenient to handle, and this mixture he patented in 1867 as 'dynamite'.

Nobel later on combined nitroglycerin with various nitrocellulose compounds, similar to collodion, but settled on a more efficient recipe combining another nitrate explosive, and obtained a transparent, jelly-like substance, which was a more powerful explosive than dynamite. 'Gelignite', or blasting gelatin, as it was named, was patented in 1876; and was followed by a host of similar combinations, modified by the addition of potassium nitrate and various other substances. Gelignite was more stable, transportable and conveniently formed to fit into bored holes, like those used in drilling and mining, than the previously used compounds and was adopted as the standard technology for mining in the Age of Engineering bringing Nobel a great amount of financial success, though at a significant cost to his health. An off-shoot of this research resulted in Nobel's invention of ballistite, the precursor of many modern smokeless powder explosives and still used as a rocket propellant.

Some useful words and phrases:

– cannon and other armaments – пушки и другое вооружение
– held 350 different patents – имел 350 различных патентов
– posthumously – посмертно
– in accordance to his will – в соответствии с его завещанием
– in modern-day companies – в современных компаниях
– in his turn – в свою очередь
– diatomaceous earth – диатомит
– more convenient to handle – более удобны в обращении
– at a young age – в молодом возрасте
– a host of similar combinations – множество подобных комбинаций
– used in drilling and mining – используемые в бурении и добыче
– off-shoot of this research – побочное исследование

Assignment to text C. Make parallel translation of the following sentences from text C (from English into Russian and vice versa). Try not to peep into the ready translation.

(1) Nobel held 350 different patents, dynamite being the most famous.	(1) Нобель был обладателем 350 патентов, причем динамит был самым известным его изобретением.
(2) The mixture is thought to have originated in China.	(2) Смесь, как полагают, возникла в Китае.
(3) Alfred Nobel was a descendant of the Swedish scientist Olaus Rudbeck.	(3) Альфред Нобель был потомком шведского ученого Олафа Рудбека.
(4) The synthetic element nobelium was named after him.	(4) Синтетический элемент Нобелий был назван в честь него.
(5) Nobel later on combined nitroglycerin with various nitrocellulose compounds, similar to collodion, but settled on a more efficient recipe combining another nitrate explosive, and obtained a transparent, jelly-like substance, which was a more powerful explosive than dynamite.	(5) Нобель в последствии соединял нитроглицерин с различными соединениями нитроцеллюлозы, такими как коллодий, но остановился на более эффективном рецепте соединения другого взрывчатого нитрата и получил прозрачное желеобразное вещество, которое оказалось более сильным взрывчатым веществом, чем динамит.
(6) Gelignite was more stable, transportable and conveniently formed to fit into bored holes, like those used in drilling and mining.	(6) Гелигнит был более стабильным, транспортабельным и удобным в придании формы для того, чтобы вписаться в расточные отверстия, чем те, которые используются в бурении и горнодобыче.

GUIDED REVIEW TO LESSON one

Assignment to Lesson one (1): Choose the correct missing words in the chart below.

(1) For various reasons, such as high cost, lack of suitable boring implements, and fear of roof collapse, the use of black powder in ____ did not spread rapidly, though it was widely accepted by 1700.	**mining** **engineering** **supporting**
(2) Destructive in nature, explosives are also of immense value in many______ pursuits, such as in mining, quarrying, and engineering enterprises and in making fireworks, signal lights, and rockets.	**peaceful** **military** **organizing** **equipping**
(3) Some evidence suggests that the ___ invented black powder, and by 1300 had developed the first real gun, a bamboo tube reinforced with iron, which used a charge of black powder to fire an arrow.	**Americans** **Greeks** **Arabs**
(4) Explosives are sometimes used to ____various metals to each other.	**suspend** **bond** **promote**
(5)This is today the commonest and _____of the high explosives, for the first time enabling man to blast away great masses of rock and other obstacles with comparative safety.	**most dangerous** **safest**
(6) Dynamite consists of a mixture of the _____ nitroglycerin with some absorbent substance, or "dope," giving it a solid form.	**solid** **gaseous** **liquid**
(7) Finally, the very _____ industrial-type diamonds used for grinding and polishing are produced by the carefully controlled action of explosives on carbon	**coarse** **controllable** **fine** **distributed**

Assignment to Lesson one (2): Formulate and discuss with your class the problems put forward in Lesson one.

2. Lesson Two
FUNDAMENTAL CHARACTERISTICS OF EXPLOSIVES

PROFESSIONAL TRAINING:
Lesson TWO

Pre-text exercises to text A

1. Read the words using transcriptions. Guess about their meanings:

exothermic ["FksqV'TWmIk], **self-sustaining** ['self sq'steInIN], **expand** [Ik'spxnd], **entire** [In'taIq], **percussion** [pq'kASqn], **phenomenon** [fI'nOmInqn], **microsecond** ['maIkrqV"sekqnd], **shock** [SOk], **noise** [nOIz], **potential energy** [pq'tenSql 'FnqGI], **exert** [Ig'zWt], **release** [rI'lJs], **sudden outburst** [sAdn 'autbWst], **surroundings** [sq'raundINz], **generation** ["GFnq'reISqn], **large quantities** [lRG'kwLntItIz], **gaseous** ['gxsIqs], **worthwhile** ["wWT'waIl], **insufficient** ["Insq'fISqnt], **rapidity** [rq'pIdItI], **cause** [kLz], **explosion** [Ik'splqVZqn], **pound** [paVnd], **coal** [kqVl], **nitroglycerine** ["naItrqV'glIsqrIn]

2. Translate the following words. Refer to the transcriptions in exercise 1 for correct pronunciation.

экзотермический (химическая реакция с выделением тепла), самоподдерживающийся, расширяться, весь, ударное действие, явление, микросекунда, удар, шум, потенциальная энергия, оказывать влияние, освобождать, внезапная вспышка, окружение, образование, большие количества, газообразный, стоящий, недостаточный, быстрота, вызывать, взрыв, фунт, уголь, нитроглицерин.

3. Read the lexical program of text A. Try to memorize it.

(1) when suitably triggered	(1) при соответствующем спусковом импульсе
(2) releases a large amount of heat and pressure	(2) высвобождает большое количество тепла и давления
(3) exothermic decomposition reaction	(3) экзотермическая реакция разложения
(4) subjected to heat, percussion, detonation or catalysis	(4) подвергается воздействию тепла, ударного действия, детонации или катализа

5) a sudden outburst of gases	(5) резкий выброс газов
(6) thereby exerting high pressure on its surroundings	(6) тем самым оказывает высокое давление на его окружение
(7) accompanies every explosive chemical reaction	(7) сопровождает каждую взрывную химическую реакцию
(8) rapid generation of high pressures of released gases	(8) быстрая генерация высокого давления выделяющихся газов
(9) yields five times as much heat	(9) выделяет в пять раз больше тепла
(10) because the rate at which it yields this heat is quite slow	(10) потому что скорость, с которой он выделяет тепло, является довольно медленной

Text A. Definitions of Explosives

A study of the literature suggests that an explosive may be defined in one of the following ways:

1) An explosive is a substance which, when suitably **triggered**, releases a large amount of heat and pressure by way of a very rapid **self - sustaining exothermic decomposition reaction**. The temperature generated is in the range of 3000 – 5000° C and the gases produced expand 12 000 – 15 000 times than the original volume. The entire phenomenon takes place in a few microseconds, accompanied by a shock and loud noise.

2) An explosive is a chemical substance or a mixture of chemical substances, which when subjected to heat, **percussion**, **detonation** or catalysis, undergoes a very rapid decomposition accompanied with the production of a large amount of energy. A large volume of gases, considerably greater than the original volume of the explosive, is also liberated.

3) An explosive is a substance or device which produces, upon release of its potential energy, a sudden **outburst of gases** thereby exerting high pressure on its surroundings.

The generation of heat in large quantities accompanies every explosive chemical reaction. It is this rapid liberation of heat that causes the gaseous products of reaction to expand and generate high pressures.

This rapid generation of high pressures of released gases constitutes explosion. It is worthwhile to point out that liberation of heat with insufficient rapidity does not cause an explosion. For example, although a pound of coal yields five times as much heat as a pound of **nitroglycerine**, coal cannot be described as an explosive because the rate at which it yields this heat is quite slow.

Assignment to text A. Make three lists of terms for three definitions of explosives (in writing). Make sure that you remember these words.

Pre-text Exercises to Text B.

1. Read the words using transcriptions. Guess about their meanings:

compatibility ["kqmpxtq'bIlItI]**,** **consideration** [kqn"sIdq'reISqn], **sensitivity** ["sensI'tIvItI], **gases evolved** [gxsIsI'vOlvd], **sensitiveness** ['sFnsItIvnIs], **detonation** [''dFtq'neISqn], **incompatibility** ["Inkqm'pxtq"bIlItI], **explosive power** [Ik'splqVsIv pauq], **brisance** ['brJzqns], **hazardous**['hxzqdqs], **frequent** ['frJkwqnt], **necessity** [nI'sFsItI], **stringent requirements** ['strInGqntrI'kwaIqmqnts], **pyrotechnic** [''paIrqV'tFknIks], **ingredients** [In'grJdIqnts], **interior** [In'tIqrIq], **surface coatings** ['sWfIs 'kqVtINz], **luting** ['lHtIN], **potting composition** [pOtIN "kOmpq'zISqn], **assemblies** [q'sFmblIz], **deterioration** [dI'tIqrIq"reISqn], **excess** [Ik'sFs], **convert** [kqn'vWt], **rarely** ['rFqlI], **degree** [dI'grJ]

2. Translate the following words. Refer to the transcriptions in exercise 1 for correct pronunciation.

совместимость, рассмотрение, чувствительность, восприимчивость, выделяемые газы, скорость детонации, несовместимость, взрывная сила, бризантность, опасный, частый, необходимость, жесткие требования, пиротехнический, ингредиенты, внутренняя сторона, покрытия поверхностей, замазка, состав заливки, сборки, ухудшение, избыток, конвертировать, редко, степень.

3. Read the lexical program of text B. Try to memorize it.

(1) ability to be stored intimately	(1) способность храниться в тесном контакте
(2 to result in a loss of effectiveness	(2) приводить к потере эффективности
(3) sometimes may be very hazardous	(3) иногда может быть очень опасным
(4) to study their compatibility with interior surface coatings	(4) для изучения их совместимости с покрытиями внутренней поверхности
(5) sealants, luting and potting compositions used in assemblies	(5)состав герметиков, замазок и заливок, используемых в сборке
(6) to be stored without any deterioration	(6) храниться без снижения качества
(7) important parameter for identifying their potential as an explosive or oxidizer	(7) важный параметр для определения их потенциала в качестве взрывчатых веществ или окислителей
(8) explosive or **oxidizer** is said to have a 'positive' OB	(8) взрывчатое вещество или окислитель, как говорят, имеют «позитивный» Кислородный Баланс
(9) explosives are rarely perfectly balanced	(9) взрывчатые вещества редко бывают идеально сбалансированы
(10) OB is an expression that is used to indicate the degree to which an explosive can be oxidized	(10) КБ это выражение, которое используется для обозначения того, насколько взрывчатое вещество может быть окислено

Text B. Fundamental Features of Explosives: Compatibility and Stability; Oxygen Balance.

Some of the important characteristics of an explosive which are taken into consideration while selecting it for any application are:

- compatibility and stability;
- oxygen balance;
- sensitivity and sensitiveness;
- heat of formation;
- heat of explosion and gases evolved;
- velocity of detonation;
- detonation pressure;

- explosive power or strength;
- brisance.

Compatibility and Stability

Compatibility of materials may be defined as their ability to be stored intimately, that is, in close contact, without occurrence of any **chemical reaction**. Consequently, **incompatibility** is likely to result in a loss of effectiveness or sometimes may be very **hazardous**, leading to accidents.

The problem is complicated not only by the frequent necessity to meet stringent **storage and service requirements** but also by a variety of non - explosive materials used in the construction of **weapon systems**. In addition to the study of the stability and **mutual compatibility** of the **ingredients** of explosive, **propellant** and **pyrotechnic** fillings, it is also necessary to study their compatibility with **interior surface coatings** that is, **sealants**, **lutings** and **potting** compositions used in **assemblies**.

Stability is the ability of an explosive to be stored without any **deterioration** and it is affected by the following factors: 1) Temperature of storage; 2) Chemical constitution; 3) Exposure to sunlight; 4) Electrostatic discharge.

Oxygen Balance (OB)

The concentration of oxygen within an explosive or **oxidizer** is represented by a term known as '**oxygen balance'** (OB represented by Ω) which is an important parameter for identifying their potential as an explosive or oxidizer. Oxygen balance may be defined as the amount of oxygen remaining after the oxidation of hydrogen, carbon and metals (like Mg, Al etc.) to produce H2 O, CO2, MgO, Al2O 3etc. If excess of oxygen remains after the **oxidation reaction**, explosive or **oxidizer** is said to have a 'positive' OB. On the other hand, if the oxygen is completely consumed and excess fuel remains, explosive or oxidizer is said to have a 'negative' OB. Thus OB values can be positive or negative. However, if an explosive molecule contains just enough oxygen to convert all its carbon (C) to carbon dioxide (CO2), all its hydrogen to water (H2O) and all its metal to metal oxide with no excess, the explosive is said to have a zero OB, but explosives are rarely **perfectly balanced**. In other words, **OB** is an expression that is used to indicate the degree to which an explosive can be oxidized.

Assignment to text B. Read text B again and write out the words in black type. Give the meanings of these terms.

Pre-text Exercises to Text C

1. Read the words using transcriptions. Guess about their meanings:

researcher [rI'sWCq]**,** **detonation** ["dFtq'neISqn], **gunpowder** ['gAn"paVdq], **combustion** [kqm'bAsCqn], **undoubtedly** [An'daVtIdlI], **pressure** ['prFSq], **merit** ['mFrIt], **technique** [tFk'nJk], **dissolve** [dI'zOlv], **swell** [swFl], **poorly**['pVqlI], **gelatinous** [GI'lxtInqs], **homogeneous** ["hqVmq'GJnIqs], **pure** [pjuq], **alcohol** ['xlkq"hOl], **ether** ['JTq], **smokeless powder** ['smqVklIs'paudq], **thickness** ['TIknIs], **configuration** [kqn"flgju'reISqn], **grain** [greIn], **flake** [fleIk], **string** [strIng], **plate** [pleIt], **pasta** [pxstq], **multi-channel tubes** ['mAltI-CxnqltjHbz], **stick** [stIk]

2. Translate the following words. Refer to the transcriptions in exercise 1 for correct pronunciation.

исследователь, детонация, порох, горение, несомненно, давление, заслуга, метод, растворять, разбухать, плохо, желатиновый, гомогенный, чистый, спирт, эфир, бездымный порох, толщина, конфигурация, зерно, чешуйка, струна, пластинка, макароны, многоканальные трубы, палка.

3. Read the lexical program of text B. Try to memorize it.

(1) The theory of gunpowder combustion	(1) Теория горения пороха
(2) He carried out a lot of important research	(2) Он провел много важных исследований
(3) The burning rate of solid explosives	(3) Скорость горения твердых взрывчатых веществ
(4) It was not clear how to implement it	(4) Не было ясно, как его реализовать
(5) The stubborn "shooting cotton" persistently refused to dissolve in anything.	(5) Упрямый "стреляющий хлопок" упорно отказывался растворяться в чем-либо.
(6) It is of utmost importance	(6) Чрезвычайно важно
(7) To distill off the solvent	(7) Отогнать растворитель
(8) He wanted to dissolve pyroxyline in a suitable solvent	(8) Он хотел растворить пироксилин в подходящем растворителе
(9) Forming a thick gelatinous translucent homogeneous mass	(9) Образуя густую полупрозрачную желатиновую однородную массу

Text C. Pail Marie Eugène Vieille (from Wikipedia)

Paul Marie Eugène Vieille was born in 1854. After graduating the Ecole Polytechnique, he immediately moved into the front ranks of researchers of explosives. During the long years he carried out a lot of important research in the field of detonation of explosives, methods of research and testing, developing the theory of gunpowder combustion. He established the so-called "Law of Vielle," linking the burning rate of solid explosives with pressure, but his main merit is undoubtedly the invention of smokeless gunpowder.

To solve the fundamental problem of creating gunpowder it is of utmost importance to form completely homogeneous pyroxyline mass. For this purpose Vielle intended to apply an extremely simple technique. He wanted to dissolve epyroxyline in a suitable solvent, then distilling off the solvent, obtain a uniform density material instead off ibrous wadding. The plan was good, but it was not clear how to implement it.

The stubborn "shooting cotton" persistently refused to dissolve in anything. Only after a long search Vielle found that gun-cotton is not really soluble, but at least it swells (and does that poorly) in a mixture of alcohol and ether. Another long string of sleepless nights helped Vielle establish that he does not need to dissolve pure gun-cotton, but its mixture with collodion. This mixture, prepared in the desired proportion, swells in an alcohol-ether solvent, such as gelatin in water, to form a thick gelatinous translucent homogeneous mass.

Gelation - the main condition for obtaininga good dense homogeneous powder. It is precisely the essence of Vielle's invention.

The possibility of formation of coarse grains is an important advantage of smokeless powder. Smokeless powder is durable and easy to be molded to any thickness and grain configuration. Modern gunpowder is no longer a powder and "grain" - no longer grains, although they are still called so. Gunpowder is molded in the form of flakes, strings, plates, pasta, multi-channel tubes, sticks, its weight sometimes being tens of pounds, but according to tradition, all these forms are still called grains.

Assignment to text C. **Make parallel translation of the following sentences from text C (from English into Russian and vice versa). Try not to peep into the ready translation.**

(1) In the front ranks of researchers of explosives.	(1) В передних рядах исследователей взрывчатых веществ.
(2) Vielle intended to apply an extremely simple technique.	(2) Вьель намеривался использовать чрезвычайно простой метод.
(3) Another long string of sleepless nights helped Vielle establish that he does not need to dissolve pure gun-cotton, but its mixture with collodion.	(3) Еще одна длинная вереница бессонных ночей помогла Вьелю установить, что он должен растворять не чистый пироксилин, а его смесь с коллодием.
(4) Modern gunpowder is no longer a powder and "grain" - no longer grains, although they are still called so.	(4) Современные пороха уже не порошки, а «зерно» - уже не зерно, хотя они все еще называются так.

GUIDED REVIEW TO LESSON two

Assignment to Lesson two (1):
Choose the correct missing words in the chart below.

(1) An_______________ is a substance which, when suitably triggered, releases a large amount of heat and pressure by way of a very rapid self - sustaining exothermic decomposition reaction.	**gunpowder** **gun-cotton** **explosive** **chemicals**
(2) The entire phenomenon takes place in a few microseconds, accompanied by a________ and loud noise.	**mixture** **burning** **wind** **shock**
(3) It is worthwhile to point out that liberation of heat with insufficient_______________ does not cause an explosion.	**shock** **rapidity** **temperature**

(4) ____________ of materials may be defined as their ability to be stored intimately, that is, in close contact, without occurrence of any chemical reaction.	**compatibility** **reactivity** **tensile strength**
(5)In addition to the study of the stability and mutual compatibility of the _________ of explosive, propellant and pyrotechnic fillings, it is also necessary to study their compatibility with interior surface coatings that is, sealants, lutings and potting compositions used in assemblies.	**fillings** **ingredients**
(6) The concentration of oxygen within an explosive or oxidizer is represented by a term known as '____________'.	**'oxygen balance'** **'acceleration force'**
(7) On the other hand, if the oxygen is completely consumed and excess fuel remains, explosive or oxidizer is said to have a 'negative' OB.	**consumed** **controllable** **distributed**
(8) Thus OB values can be positive or ____________.	**neutral** **negative** **high**
(9) During the long years he carried out a lot of important ____________ in the field of detonation of explosives, methods of research and testing, developing the theory of gunpowder combustion.	**study** **investigation** **research**
(10) Vielle intended to apply an extremely simple _________.	**method** **technique**

Assignment to Lesson two (2):

Formulate and discuss with your class the problems put forward in

3. Lesson Three
CLASSIFICATION OF EXPLOSIVES AND THEIR SPECIAL CHARACTERISTICS

PROFESSIONAL TRAINING: Lesson three

Pre-text exercises to text A

1. Read the words using transcriptions. Guess about their meanings:

deflagrating ['dJflq"greItIN], **primarily** [praI'merqlI], **propelling** [prq'pelIN], **ignition** [Ig'nISqn], **shattering** ['SxtqrIN], **unstable** [An'steIbl], **molecules** ['mOlIkjHl], **rapid shock waves** ['rxpId SOk weIvz], **trinitrotoluene** ["traInaItrq'tOljuJn], **dynamite** ['daInqmaIt], **nitrocellulose** ["naItrqu'seljH"lqus], **nitroglucerin** ["naItrqu'glHsqrIn], **picric acid** ['pIkrIk xsId], **cyclonite** ['saIklqnaIt], **ammonium nitrate** [q'mLnIjum 'naItreIt], **blasting** ['blRstIN], **categorize** ['kxtqgqraIz]

2. Translate the following words. Refer to the transcriptions in exercise 1 for correct pronunciation.

быстро сгорающий, в первую очередь, метательный, зажигание, дробление, молекулы, быстрые ударные волны, тринитротолуол, динамит, нитроцеллюлоза, нитроглицерин, пикриновая кислота, гексоген, аммиачная селитра, взрывные работы, подразделять на категории

3 .Read the lexical program of text A. Try to memorize it.

(1) low explosive	(1) маломощное, медленно горящее взрывчатое вещество
(2) high explosive	(2) мощное взрывчатое вещество
(3) undergo explosive decomposition without any external source	(3) подвергаются взрывному разложению без какого-либо внешнего источника
(4) relatively small amount of heat or pressure	(4) относительно небольшое количество тепла или давления

(5) explosives (e.g., TNT) are used mainly for shattering	(5) взрывчатые вещества (например, тринитротолуол) используются в основном для дробления
(6) may be categorized by the speed	(6) могут быть классифицированы по скорости
(7) civil explosives for commercial purposes	(7) гражданские взрывчатые вещества для коммерческих целей
(8) explode faster than the speed of sound	(8) взорваться быстрее, чем скорость звука
(9) Sensitive materials that can be initiated by a relatively small amount of heat or pressure	(9) Чувствительные материалы, которые могут быть инициированы относительно небольшим количеством тепла или давления
(10) The remainder are too dangerous, sensitive, toxic, expensive, unstable, or decompose too quickly for common usage.	(10)Остальные слишком опасны, чувствительны, токсичны, дороги, нестабильны, или разлагаются слишком быстро для общего использования.

Text A. Classification of Explosives

Chemical explosives can be classified as low or high explosives. Low (or **deflagrating**) explosives are used primarily for propelling; they are mixtures of readily combustible substances (e.g., gunpowder) that when set off (by **ignition**) undergo rapid combustion. High (or detonating) explosives (e.g., TNT) are used mainly for **shattering**; they are unstable molecules that can undergo explosive decomposition without any external source of oxygen and in which the chemical reaction produces **rapid shock waves**. Important explosives include **trinitrotoluene** (TNT), **dynamite**, **nitrocellulose**, **nitroglycerine**, and **picric acid**. **Cyclonite** (RDX) was an important explosive in World War II. **Ammonium nitrate** is of major importance in **blasting**.

So explosive materials may be **categorized** by the speed at which they expand. Materials that detonate (explode faster than the speed of sound) are said to be "high explosives" and materials that deflagrate are said to be "low explosives". Explosives may also be categorized by their sensitivity. Sensitive materials that can be initiated by a relatively small amount of heat or pressure are primary explosives and materials that are relatively insensitive are secondary or tertiary explosives.

A wide variety of chemicals can explode; a smaller number are manufactured in quantity as explosives. The remainders are too dangerous, sensitive, toxic, expensive, unstable, or decompose too quickly for common usage.

Explosives are used for constructive as well as destructive purposes for both military and civil applications. There are several ways of classifying explosives and a few important ones are:

- according to their end - use for example, military explosives for military
  applications whereas civil explosives for commercial purposes;
- according to the nature of explosion for example, mechanical, nuclear or chemical;
- according to their chemical structure that is, the nature of bonds present in an explosive.

Assignment to text A. Read text A again and make a list of types of explosives (in writing).

Pre-text Exercises to Text B

1. Read the words using transcriptions. Guess about their meanings:

propagating capability ['prOpqgeItIN "keIpq'bIlqtI], **converse**[kqn'vWs], **customary** ['kAstqmqrI], **synonymously** [sI'nOnImqslI], **friction** ['frIkSqn], **spark** [spRk], **characteristics** ["kxrqktq'rIstIks], **properties** ['prOpqtIz], **constituents** [kqn'stItjuqnts], **exothermic** ["eksqu'TWmIk], **original** [q'rIGqnql], **appear** [q'pIq], **kilocalories** ['kIlqu 'kxlqrI], **absorb** [qb'zLb], **give off** [gIv 'Of], **ease** [Jz], **value** ['vxljH], **impact** ['Impxkt]

2. Translate the following words. Refer to the transcriptions in exercise 1 for correct pronunciation.

способность распространяться, обратное утверждение, обычный, как синонимы, трение, искра, характеристика, свойства, компоненты, экзотермический, первоначальный, возникать, килокалории, поглощать, отдавать, легкость, значение, удар

3. Read the lexical program of text B. Try to memorize it.

(1) It is customary to use ‘sensitivity’ to mean ‘ease of initiation’	(1) Принято использовать термин ‘чувствительность’ в смысле ‘простоты инициирования’
(2) ‘Sensitivity’ and ‘sensitiveness’ are referred to in the context of explosives	(2) «Чувствительность» и «способность быстро реагировать» - это термины, к которым прибегают, говоря о взрывчатых веществах
(3) Sensitivity to Impact	(3) Чувствительность к воздействиям
(4) Sensitivity to Friction	(4) Чувствительность к трению
(5) Sensitivity to Shock	(5) Чувствительность к удару
(6) Sensitivity to Spark	(6) Чувствительность к искрам
(7) Sensitivity to Heat	(7) Чувствительность к теплу
(8) the study of their chemical characteristics and evaluation of their explosive properties	(8) изучение их химических характеристик и оценка их взрывчатых свойств
(9) the ‘heat content ’ of an explosive is equal to its ‘ heat of formation’	(9)' теплосодержание' ВВ равно его "теплоте образования"
(10) the reactions are always exothermic	(10) реакции всегда экзотермические

Text B. Fundamental Features of Explosives: Sensitivity and Sensitiveness; Heat of Formation

These two terms: ‘**sensitivity**’ and ‘**sensitiveness**’ are referred in the context of explosives, propellants and pyrotechnics and relate to two rather similar properties of explosives that is, ‘**ease of initiation’** and ‘**propagating capability**’. It is customary to use ‘sensitivity’ to mean ‘ease of initiation’ whereas ‘sensitiveness’ to mean ‘propagating capability’. In others, the converse is believed to be true and in yet others, these terms are used synonymously. There are mainly five types of sensitivity: 1) **Sensitivity to Impact**; 2) **Sensitivity to Friction**; 3) **Sensitivity to Shock**; 4) **Sensitivity to Spark**; 5) **Sensitivity to Heat**.

The ‘heat of formation’ of explosives is of fundamental importance for the study of their chemical characteristics and evaluation of their **explosive properties**. When a chemical compound is formed from its

constituents, the reaction may either absorb or give off heat, which is called ‘heat of formation’ and is expressed in units of kilocalories per gram molecule. The value of the ‘heat of formation ’can be negative or positive. The negative value indicates absorption of heat during the formation of compound from its elements and such a reaction is called an ‘**endothermic**’ reaction whereas a positive value indicates liberation of heat during the formation of compound meaning the reaction is ‘**exothermic**’. For explosives, the reactions are always exothermic. In an exothermic reaction, the energy evolved may appear in many forms, but for practical purposes, it is usually in the form of heat. Since the ‘heat of formation ’ of an explosive is the net difference between ‘**heat content’** of the explosive and that of its elements (taken as zero by convention), it means that the ‘heat content ’ of an explosive is equal to its ‘ heat of formation’. The net amount of heat liberated during an explosion is the sum of ‘**heats of formation’** of the **products of explosion**, minus the ‘heat of formation’ of the original explosive.

Assignment to text B. Read text B and write out the words in black type. Give the meanings of these terms. (You may use the Glossary of Terms at the end of this book).

Pre-text Exercises to Text C

1. Read the words using transcriptions. Guess about their meanings:

mankind [mxn'kaInd], **situation** ["sItju'eISqn], **thoroughly** ['TArqlI], **needed** ['nJdId], **further** ['fWDq], **technological progress** ["teknq'lOGIkql 'prOgrqs], **war captives** [wL 'kxptIvz], **hack out** [hxk aut], **inhabitants** [In'hxbItqnts], **temples** [templz], **passageways** ['pxsIGweI], **chisels and wedges** ['CIzqlz qnd weGIz], **alleviate**[q'lIvIeIt], **drudgery** ['drAGqrI], **wealth of earth** [welT qv WT], **available** [q'veIlqbl], **mountains**['mauntInz], **tame** [teIm], **mine minerals** [maIn mIneral], **hazardous terrain** ['hxzqdqs tqreIn], **overwhelming** ["quvq'welmIN], **prosperity** [prOs'perItI], **invention** [In'venSqn], **perceive** [pq'sJv], **devil** ['devIl], **evil** ['Ivql], **angel** ['eInGql], **processing** ['prqusesIN], **handling** ['hxndlIN], **transportation** ["trxnspL'teISqn], **storage** ['stLrIG], **treatises** ['trJtIz]

2. Translate the following words. Refer to the transcriptions in exercise 1 for correct pronunciation.

человечество, ситуация, совершенно, необходимый, дальнейший, технический прогресс, военнопленные, вырубать, жители, храмы, проходы, зубила и клинья, облегчить, тяжелая работа, богатство земли, доступный горы, добывать полезные ископаемые, опасная местность, ошеломляющий, процветание, изобретение, воспринимать, дьявол, зло, ангел, обработка, обращение, транспортировка, хранение, трактаты

3. Read the lexical program of text B. Try to memorize it.

(1) explosives were thoroughly needed	(1) взрывчатые вещества были совершенно необходимы
(2) further technological progress	(2) дальнейший технический прогресс
(3) tunneled their way through rock	(3) прорубали туннели сквозь скалы
(4) by hacking out passageways with chisels and wedges.	(4) вырубая проходы с помощью зубил и кольев
(5) to provide ways and means	(5) найти пути и средства
(6) to alleviate this drudgery	(6) чтобы облегчить эту тяжелую работу
(7) considerable technological progress	(7) значительный технический прогресс
(8) to move mountains, tame rivers, mine minerals	(8) передвигать горы, укрощать реки и добывать полезные ископаемые
(9) today's fantastic engineering projects	(9) сегодняшние фантастические инженерные проекты
(10) exploration of space	(10) освоение космоса

Text C. Civil Uses of Explosives.

In the history of mankind there were many situations where something like explosives were thoroughly needed for solving problems of further technological progress. For example,

- War captives were used to hack out hundreds of miles of mines, irrigation canals and for other constructions by the ancient Egyptians.
- The inhabitants of the Aegean Island of Samos tunneled their way through rock for water supply in the sixth century BC.
- A large number of temples and forts were carved out of the rocks in India and the Far East.
- Hannibal crossed the Alps by hacking out passageways with chisels and wedges.

Explosives were used to provide ways and means to alleviate this drudgery. It was more efficient and economical to bring down rocks or do mining with the use of gunpowder, the first explosive, than by any other previous means. Explosives are generally associated with a destructive role but their important contributions are very often lost sight of. In fact, it was the power of explosives which made the great industrial revolution possible in Europe and also made the mineral wealth of earth available to mankind.

Considerable technological progress in the development and applications of explosives has made it possible to move mountains, tame rivers, mine minerals from deep underground and also link continents and countries by roads and rails through difficult and hazardous terrain. Explosives continue to play an overwhelming role in the progress and prosperity of mankind right from the time of invention of black powder or gunpowder several centuries ago. In fact, some of today's fantastic engineering projects and exploration of space would have not been possible without the use of explosives.

Explosives, in a nutshell, are generally perceived as 'devil' during war and considered as an 'evil' during processing, handling, transportation and storage, have proved to be an 'angel' due to their tremendous impact on economy and industries.

Explosives have contributed enormously in improving the economy of many countries and their chemistry forms the basis of many well - known treatises.

Some useful words and phrases:

– in the history of mankind – в истории человечества
– thoroughly needed – совершенно необходимый
– in a nut shell – в двух словах
– ways and means– пути и способы
– to bring down rocks – рушить скалы

– than by any other previous means – чем каким-либо иным, существовавшим ранее способом
– applications of explosives has made it possible – применение взрывчатых веществ сделало возможным
– to hack out hundreds of miles of mines – прорубать шахты на глубину сотен миль
– during processing, handling, transportation and storage – вовремя обработки, обращения, транспортировки и хранения
– to mine minerals from deep underground – добывать минералы глубоко под землей
– made the great industrial revolution possible – сделали великую промышленную революцию возможной

Assignments to text C. Make parallel translation of the following sentences from text C (from English into Russian and vice versa). Try not to peep into the ready translation.

(1) In the history of mankind there were many situations where something like explosives were thoroughly needed	(1) В истории человечества было много ситуаций, когда что-то вроде взрывчатых веществ было абсолютно необходимо
(2) War captives were used to hack out hundreds of miles of mines, irrigation canals and for other constructions by the ancient Egyptians.	(2) Военнопленные использовались для вырубания сотен миль шахт, оросительных каналов и других сооружений древних египтян.
(3) A large number of temples and forts were carved out of the rocks in India and the Far East.	(3) Большое количество храмов и крепостей были вырезаны из скал в Индии и на Дальнем Востоке
(4) Explosives were used to provide ways and means to alleviate this drudgery.	(4) Взрывчатые вещества были использованы для обеспечения путей и средств облегчения этой тяжелой работы
(5) Explosives are generally associated with a destructive role but their important contributions are very often lost sight of	(5) Взрывчатые вещества, как правило, ассоциируются с деструктивной ролью, но их важный вклад очень часто упускается из виду

окончание таблицы

(6) In fact, it was the power of explosives which made the great industrial revolution possible in Europe	(6) На самом деле, именно сила взрывчатых веществ сделала возможной великую промышленную революцию в Европе
(7) Explosives continue to play an overwhelming role in the progress and prosperity of mankind right from the time of invention of black powder or gunpowder several centuries ago.	(7) Взрывчатые вещества продолжают играть всеохватывающую роль в прогрессе и процветании человечества со времен изобретения черного пороха несколько веков назад.

GUIDED REVIEW TO LESSON Three

Assignment to Lesson three (1):Choose the correct missing words in the chart below.

(1) Important explosives include________ (TNT), dynamite, nitrocellulose, nitroglycerine, and picric acid.	**nitric acid** **black powder** **trinitrotoluene**
(2) So explosive materials may be _______ by the speed at which they expand.	**categorized** **organized** **equipped**
(3) Explosives are used for _______ as well as destructive purposes for both military and civil applications.	**eliminated** **prohibited** **constructive**
(4). It is customary to use ‘sensitivity’ to mean ‘ease of initiation’.	**initiation** **promotion**
(5)When a chemical compound is formed from its _____________, the reaction may either absorb or give off heat, which is called ‘heat of formation’ and is expressed in units of kilocalories per gram molecule.	**parts** **bodies** **constituents**

(6) The negative value indicates absorption of heat during the formation of compound from its elements and such a reaction is called an ‘______________’ reaction	**exothermic** **endothermic** **reverse**
(7) In an exothermic reaction, the energy evolved may appear in many forms, but for practical purposes, it is usually in the form of ____________.	**explosive** **heat** **distribution**
(8) It was more efficient and economical to bring down rocks or do mining with the use of __________, the first explosive, than by any other previous means.	**dynamite** **gunpowder**
(9) Explosives continue to play an overwhelming role in the progress and prosperity of mankind right from the time of_____of black powder or gunpowder several centuries ago.	**finding** **invention** **mining**
(10) In fact, some of today's fantastic engineering projects and ___________ of space would have not been possible without the use of explosives.	**conquering** **investigation** **exploration**
(11) Explosives have contributed enormously in improving the economy of many countries and their chemistry forms the basis of many well - known ______	**principles** **content** **treatises**

Assignment to Lesson three (2):

Formulate and discuss with your class the problems put forward in Lesson one.

4. Lesson Four
EXPLOSIVES AND A BRIEF HISTORY OF THEIR INVENTION

PROFESSIONAL TRAINING: Lesson four

Pre-text exercises to text A

1. Read the words using transcriptions. Guess about their meanings:

velocity [vI'lOsItI], **obstacle** ['Obstqkl], **excavation** ["ekskq'veISqn], **quarrying** ['kwOrIIN], **employ** [Im'plOI], **concrete** ['kONkrJt], **setting** [setIN], **slurry** ['slWrI], **pour**[pL], **boulder** ['bquldq], **silicate** ['sIlIkeIt], **adverse** ['xdvWs], **advantageous** ["xdvqn'teIGqs]

2. Translate the following words. Refer to the transcriptions in exercise 1 for correct pronunciation.

скорость, препятствие, земляные работы, разрабатывать карьер, использовать, цемент, затвердевание, жидкое цементное тесто, наливать, валун, силикат, неблагоприятный, благоприятный

3. Read the lexical program of text A. Try to memorize it.

(1) velocity of detonation	(1) скорость детонации
(2) explosives help us to construct tunnels and remove obstacles during road construction	(2) взрывчатые вещества помогают нам построить туннели и устранение препятствий при строительстве дорог
(3) large-scale excavation work	(3) крупномасштабные земляные работы
(4) dismantling and clearing of structures and buildings	(4) демонтаж и очистка зданий и сооружений
(5) ‘Acconex’ is a non - explosive demolition agent	(5) ‘Аконекс’ это невзрывной агент, используемый при сносе зданий
(6) produces cracks while setting	(6) вызывает трещины при затвердевании
(7) with the passage of time	(7) со временем
(8) high expansive stresses	(8) высокие расширительные нагрузки
(9) crack initiation	(9) зарождение трещин
(10) depending upon nature and size of the target and the temperature	(10) в зависимости от природы и размера цели и температуры

Text A. Explosives in Civil Engineering

Explosives with high VOD (velocity of detonation) have a blasting or shattering effect. As a result, explosives help us to construct tunnels and remove obstacles during road construction.

In large-scale excavation work, a technique similar to those used in quarrying is employed. Explosives have been found useful in demolition work (dismantling and clearing of structures and buildings). Explosives have also been extensively used to demolish structures made of stone, brick, concrete, steel and timber. For cutting action, FLSCs have also been used whereas for demolition both **conventional explosives** (RDX, HMX etc.) and **silent explosive** (Acconex) have been used.

‘Acconex’ is a non - explosive demolition agent – a special type of expanding cement which produces cracks while setting, has been developed by one of the DRDO laboratories. The cement when mixed with 25 – 30% water forms a slurry which is poured into pre - drilled holes of about 65 – 70% of the size of the boulder, rock or target. The slurry sets in about 15 minutes and with the passage of time, it develops high expansive stresses due to the presence of special silicates in the composition.

The phenomenon of demolition occurs with crack initiation. Propagation of cracks from hole increases in number. The process of cracking takes between 24 and 72 hours, depending upon nature and size of the target and the temperature. The most important feature of Acconex is that it demolishes rocks or concrete structures without any noise or adverse effect on neighboring structures. This is advantageous when demolishing is done in densely populated and built - up areas.

Further, it does not cause any pollution as no gases are liberated.

Assignment to text A. Read text A and make a list of useful deeds of explosives, add more information if you know (in writing) Discuss it in your group.

Pre-text Exercises to Text B

1. Read the words using transcriptions. Guess about their meanings:

adiabatic ["xdIq'bxtIk], **calculate** ['kxlkjuleIt], **denoted** [dI'nqutId], **essential** [I'senSql], **knowledge** ['nOlIG], **during** ['djuqrIN], **measure** ['meZq], **tedious** ['tIdIqs], **establish** [Is'txblIS], **enable** [I'neIbl], **performance** [pq'fOmqns],

among [q'mAN], **volume** ['vOljum], **occupy** ['OkjupaI], **consider** [kqn'sIdq], **equilibrium** ["ekwI'lIbrIqm], **constant** ['kOnstqnt], **molar** ['mqulq]

2. Translate the following words. Refer to the transcriptions in exercise 1 for correct pronunciation.

адиабатический, рассчитывать, обозначенный, существенный, знание, во время, измерять, муторный, устанавливать, создавать возможность, действие,comparison,сравнение, среди, объем, занимать, полагать, равновесие, постоянная, молярный

3. Read the lexical program of text B. Try to memorize it.

(1) heat so released under adiabatic conditions	(1) тепло, освобожденное таким образом при адиабатических условиях
(2) may be calculated from equilibrium constants	(2) могут быть вычислены из констант равновесия
(3) knowledge of the composition of the gaseous products of explosion	(3) знание о составе газообразных продуктов взрыва
(4) the volume of gaseous products produced during an explosion	(4) объем газообразных веществ, образующихся при взрыве
(5) provides information on the amount of work done by an explosive	(5) предоставляет информацию о количестве работы, проделанной взрывом
(6) standard conditions are established	(6) устанавливаются стандартные условия
(7) the volume of gas varies according to the temperature	(7) объем газа изменяется в зависимости от температуры
(8) one mole of any gas occupies 22.4 liters	(8) один моль любого газа занимает 22,4 литров
(9) under the conditions of STP (Standard Temperature and Pressure)	(9) в условиях STP (стандартная температура и давление)
(10) explosive is initiated to rapid burning and detonation	(10) взрывчатое вещество инициируется, чтобы произошло быстрое горение и детонация

Text B. Fundamental Features of Explosives: Heat of Explosion and Gases Evolved

When an explosive is initiated to rapid burning and detonation, energy is released in the form of heat mainly due to the **oxidation reactions**. The heat so released **under adiabatic conditions** is called the ‘heat of explosion’, denoted by the letter *Q* which is a very important characteristic of an explosive and provides information about its **work capacity**. To calculate ‘heat of explosion’ and other **explosive performance parameters**, a knowledge of the composition of the gaseous products of explosion is considered essential. This may be calculated from **equilibrium constants** of the water gas and other reactions which is a tedious process. Also, the volume of gaseous products produced during an explosion provides information on the amount of work done by an explosive.

To measure the volume of gases produced during explosion, standard conditions are established as the volume of gas varies according to the temperature. The standard conditions also enable comparison among the gaseous products of explosion of various explosives. The **standard temperature** and **standard pressure** are 0°C/273 K and 1 atm respectively. These conditions are known as ‘standard temperature and pressure’ (STP). Under these standard conditions, one mole of any gas occupies 22.4 liters which is known as the molar gas volume.

Avogadro’s Law states that equal volumes of all gases under the conditions of **STP** (**Standard Temperature and Pressure**) contain the same number of molecules. It implies that the molar volume of one gas is equal to the molar volume of any other gas, that is, the molar volume of any gas at 0 ° C and 1 atm pressure is very close to 22.4 liters.

Assignment to text B. Read text B and write out the words in black type. Give the meanings of these terms.

Pre-text Exercises to Text C

1. Read the words using transcriptions. Guess about their meanings:

saltpeter ["sOlt'pJtq], **reportedly**[rI'pLdIdlI], **sulphur** ['sAlfq], **charcoal** ['CRkqul], **Chinese** ['CaI'nJz], **invention** [In'venSqn], **incendiary** [In'sendIqrI], **projectiles** [prq'GektaIlz], **catapult** ['kxtqpAlt], **munitions** [mjH'nISqnz], **factories** ['fxktqrIz], **rocket** ['rOkIt], **bombs** [bOmz], **weaponry** ['wepqnrI],

propel [prq'pel], **gunpowder** ['gAn"paudq], **thunder** ['TAndq], **crash** [krxS], **troops** [trHps], **besiege** [bI'sJG], **Empire** ['empaIq], **unleash** [An'lJS], **barrel** ['bxrql], **observation** ["Obzq'veISqn], **European** ["juqrq'pJqn], **cannon** ['kxnqn], **arms** [Rmz], **assault** [q'sLlt]**, craftsman** ['krRftsmqn]

2. Translate the following words. Refer to the transcriptions in exercise 1 for correct pronunciation.

селитра, по сообщениям, сера, древесный уголь, китайский, изобретение, зажигательный, снаряды, катапульта, боеприпасы, заводы, ракета, бомба, вооружение, приводить в движение, порох, треск, войска, осаждать, империя, выпускать (снаряд), ствол ружья, наблюдение, европеец, пушка, оружие, нападение, ремесленник

3. Read the lexical program of text B. Try to memorize it.

(1) a Chinese invention	(1) китайское изобретение
(2) date to the 800s	(2) датируется восьмисотыми годами
(3) The Chinese used gunpowder to propel rockets	(3) Китайцы использовали порох, чтобы запускать ракеты
(4) weaponry included a so-called "thunder-crash bomb",	(4) оружие включало так называемые "бомбы, поражающие громом"
(5) the Chinese invented cannons	(5) китайцы изобрели пушки
(6) embraced gunpowder with enthusiasm	(6) приняли порох с энтузиазмом
(7) acting merely as curious adjuncts	(7) действуя лишь в качестве любопытных дополнений
(8) During the later years of the 13th century	(8) В последующие годы тринадцатого века

Text C. Invention of Gunpowder.

Gunpowder, reportedly produced from saltpetre, sulphur and charcoal, is a Chinese invention. Earliest records of the formula date to the 800s. The Chinese used **gunpowder** to propel rockets, and to produce **incendiary** and explosive projectiles thrown by catapult. By the 1200s, a Chinese Bureau of Munitions was operating seven factories that produced 7,000 rockets and 21,000 bombs a day. The **weaponry** included a so-called "thunder-crash bomb", which the Chinese unleashed in 1232 on Mongol troops besieging Kaifeng, capital of the north Chinese Jin Empire. During the later years of the 13th century, the Chinese invented cannons, using gunpowder to fire projectiles from metal barrels.

One of the first recorded applications of gunpowder in European military history occurred at the 1346 Battle of Crecy, where the English arsenal included little gunpowder "firepots." These had little impact on the outcome of the battle, acting merely as curious adjuncts to the English longbows that won the day. By 1350, however, Petrarch was able to make the observation that guns had become "... as common and familiar as any other kind of arms." The Ottoman Turks embraced gunpowder with enthusiasm, using it with spectacular effect during their assault on Constantinople in 1453. In preparation for the attack, Mehmet II hired a European craftsman to manufacture seven huge cannons, including one 25-ton monster that could fire stone balls almost a mile. (http://timelineindex.com/content/view/1119)

Assignment to text C. Make parallel translation of the following sentences from text C (from English into Russian and vice versa).

(1) Gunpowder, reportedly produced from saltpetre, sulphur and charcoal, is a Chinese invention.	(1) Как сообщается, порох, производимый из селитры, серы и древесного угля, является китайским изобретением.
(2) Earliest records of the formula date to the 800s.	(2) Первые записи о формуле датируются 800-ми годами.
(3) The Chinese invented cannons, using gunpowder to fire projectiles from metal barrels.	(3) Китайцы изобрели пушки, используя порох, чтобы стрелять снарядами из металлического дула.
(4) One of the first recorded applications of gunpowder in European military history occurred at the 1346 Battle of Crecy, where the English arsenal included little gunpowder "firepots."	(4) Одно из первых зарегистрированных применений пороха в европейской военной истории относится к 1346 году, когда во время битвы при Креси англичане имели в своем арсенале маленькие "огненные горшочки" с порохом.
(5) By 1350, however, Petrarch was able to make the observation that guns had become "... as common and familiar as any other kind of arms."	(5) К 1350 году, однако, Петрарка сделал вывод, что огнестрельное оружие стало "...таким же распространенным и знакомым, как любой другой вид оружия".
(6) The Ottoman Turks embraced gunpowder with enthusiasm, using it with spectacular effect during their assault on Constantinople in 1453.	(6) Турки Османской империи приняли порох с энтузиазмом, используя его с захватывающим дух эффектом в ходе наступления на Константинополь в 1453 году.

GUIDED REVIEW TO LESSON Four

Assignment to Lesson four (1): Choose the correct missing words in the chart.

(1) Explosives with high VOD (velocity of detonation) have a blasting or ___________ effect.	**shattering** **voting** **entering** **voicing**
(2) Explosives have been found useful in __________ work (dismantling and clearing of structures and buildings).	**demolition** **providing** **organizing** **equipping**
(3)The phenomenon of demolition occurs with crack initiation.	**propagation** **prohibition** **initiation**
(4) The cement when mixed with 25 – 30% water forms a _______ which is poured into pre - drilled holes of about 65 – 70% of the size of the boulder, rock or target.	**suspend** **slurry** **solution**
(5)The heat so released under _________ conditions is called the 'heat of explosion', denoted by the letter Q which is a very important characteristic of an explosive and provides information about its work capacity.	**initiation** **adiabatic**
(6) This may be calculated from _______ constants of the water gas and other reactions which is a tedious process.	**equilibrium** **controllable**
(7) To measure the volume of gases produced during explosion, standard conditions are established as the volume of gas varies according to the ____________.	**production** **temperature** **weight** **distribution**
(8) The standard conditions also enable __________ among the gaseous products of explosion of various explosives.	**liability** **comparison**
(9) The Chinese used _______ to propel rockets, and to produce incendiary and explosive _______ thrown by catapult.	**gunpowder** **projectiles** **stones**
(10) In preparation for the attack, Mehmet II hired a European craftsman to manufacture seven huge _______, that could fire stone balls almost a mile.	**guns** **cannons** **projectiles**
(11). Avogadro's Law states that equal volumes of all gases under the conditions of STP (Standard Temperature and Pressure) contain the same number of ___________.	**principles** **content** **molecules**

Assignment to Lesson four (2):Formulate and discuss with your class the problems put forward in **Lesson four.**

5. Lesson Five
MILITARY EXPLOSIVES AND THEIR APPLICATIONS

PROFESSIONAL TRAINING: Lesson five

Pre-text exercises to text A

1. Read the words using transcriptions. Guess about their meanings:

comprise [kqm'praIz], **munitions** [mjH'nISqnz], **formulations** ["fLmjH'leISqn], **torpedoes** [tL'pJdquz], **grenades** [grI'neIdz], **missile** ['mIsaIlz], **warheads** ['wLhedz], **intermediates** ["Intq'mIdIIts], **boosters** ['bHstqz], **humidity**[hjH'mIdItI], **artillery shells** [R'tIlqrI Selz], **aerial bombs** ['FqrIql bOmz], **premature** ["premq'tjuq], **manufacture** ["mxnju'fxkCq], **civil** ['sIvl], **commercial** [kq'mWSql]

2. Translate the following words. Refer to the transcriptions in exercise 1 for correct pronunciation.

включать, боеприпасы, составы, торпеды, гранаты, метательный снаряд, боеголовки, промежуточные, усилители, влажность, артиллерийские снаряды, авиабомбы, преждевременный, производство, гражданский, коммерческий

3. Read the lexical program of text A. Try to memorize it.

(1) that are used in military munitions	(1) которые используются в военных боеприпасах
(2) bulk charges	(2) объемные заряды
(3) safe for handling	(3) безопасны в обращении
(4) over a wide range of temperatures and humidity	(4) в широком диапазоне температур и влажности
(5) reasonably insensitive to impact	(5) нечувствительны к ударам в рамках разумного
(6) they penetrate steel armor	(6) они пробивают стальную броню
(7) aerial time bombs	(7) авиабомбы замедленного действия
(8) premature explosion	(8) преждевременный взрыв
(9) explosives must be readily available	(9) взрывчатые вещества должны быть легкодоступны
(10) civil or commercial explosives	(10) гражданские или коммерческие взрывчатые вещества

Text A. Military Explosives

Military explosives comprise explosives and explosive compositions or formulations that are used in **military munitions** (bombs, shells, torpedoes, grenades, missile or rocket warheads). The bulk charges (**secondary explosives**) in these munitions are insensitive to some extent and are, therefore, safe for handling, storage and transportation. They are set off by means of an **explosive train** consisting of an initiator followed by intermediates or boosters.

Military explosives must be physically and chemically stable over a wide range of temperatures and humidity for a long period of time. They must be reasonably insensitive to impacts, such as those experienced by artillery shells when fired from a gun or when they penetrate steel armor. They are used for a number of applications.

They are fired in projectiles and dropped in **aerial time bombs** without premature explosion. The raw materials necessary to manufacture such explosives must be readily available for production in bulk during wartime.

The chemical explosives are sub - divided into four main types: (1) detonating or high explosives; (2) deflagrating or low explosives; (3) pyrotechnics and (4) civil or commercial explosives.

Assignment to text A. Make a list of terms denoting military explosives. Add some more information about them (in writing).

Pre-text Exercises to Text B.

1 .Read the words using transcriptions. Guess about their meanings:

instantaneously ["Instqn'teInIqslI], **reinforce** ["rJIn'fLs], **confined** [kqn'faInd], **seldom** ['seldqm], **attain** [q'teIn], **complete** [kqm'plJt], **confinement** [kqn'faInmqnt], **hydrodynamic** ["haIdrqudaI'nxmIk], **respectively** [rI'spekttvlI], **propagation** ['prOpq"geISn], **simplifies** ['sImplI"faIz], **critical diameter** ['krItIkql daI'xmItq], **express** [Iks'pres], **velocity** [vI'lOsItI], **speed** [spJd], **rate** [reIt], **theory** ['TJqrI], **borehole** ['bL"hqul], **solution** [sq'lHSqn], **cartridge** ['kRtrIG], **external** [Ik'stWnql], **commercial** [kq'mWSql], **preferable** ['prefqrqbl], **organic** [O'gxnIk], **derive** [dI'raIv]

2. Translate the following words. Refer to the transcriptions in exercise 1 for correct pronunciation.

мгновенно, подкреплять, ограниченный (замкнутый), неограниченный, редко, достигать, полное, гидродинамические, соответственно, распространение, упрощает, критический диаметр, выражать, скорость, скорость, скорость, теория, ствол скважины, решение, патрон, наружный, коммерческий, предпочтительный, органический, выводить

3. Read the lexical program of text B. Try to memorize it.

(1) High temperature and pressure gradients	(1) Высокие градиенты температуры и давления
(2) supported and reinforced by the chemical reactions	(2) поддерживаемая и подкрепляемая химическими реакциями
(3) at a considerably high speed	(3) при значительно более высокой скорости
(4) detonation waves travel through a column of an explosive at a constant speed	(4) детонационные волны проходят через колонку с взрывчатым веществом с постоянной скоростью
(5) propagation of detonation waves in an explosive	(5) распространение детонационных волн во взрывчатом веществе
(6) considerably wider than the critical diameter	(6) значительно шире, чем критический диаметр
(7) It may be expressed as a confined or unconfined value	(7) Оно может быть выражено ограниченным или неограниченным значением
(8) the confined velocity is seldom attained	(8) ограниченная скорость редко достигается
(9) complete confinement is usually impossible	(9) полное удержание, как правило, невозможно
(10) upper and lower detonation velocities respectively	(10) верхние и нижние скорости детонации соответственно

Text B. Fundamental Features of Explosives: Velocity of Detonation

Detonation is a process in which the explosive undergoes chemical reactions at a considerably high speed and produces a **shock wave** also called a **detonation wave**. High temperature and pressure gradients are generated in the wave front so that the chemical reaction is initiated instantaneously. The detonation wave propagates through the explosive, supported and reinforced by the chemical reactions. In general, except in the early stages of detonation, detonation waves travel through a column of an explosive at a constant speed, a fact which simplifies the mathematical solution of the '**hydrodynamic theory**'.

The velocity with which detonation waves travel in an explosive is called **velocity of detonation** (VOD) or in other words, detonation velocity may be defined as the rate, speed or velocity of propagation of detonation waves in an explosive. If density of the explosive is at its maximum value and also if the explosive is charged into columns which are considerably wider than the critical diameter, the VOD is a characteristic of each individual explosive and is not influenced by external factors. It increases with increase in density of packing of explosive in the column.

Detonation velocity is an important property to consider when rating an explosive. It may be expressed as a confined or unconfined value and is normally given in feet per second (fps). The **confined detonation velocity** measures the speed at which the detonation wave travels through a column of explosive within a borehole or other confined space. The **unconfined velocity** indicates this rate when the explosive is detonated in the open. Because explosives generally are used under some degree of confinement, the confined value is more significant.

The confined detonation velocity of commercial explosives varies from 5000 to 25,000 fps. With **cartridge explosives**, the confined velocity is seldom attained because complete confinement is usually impossible. For blasting in hard rock, a high-velocity explosive is preferable.

The detonation velocities of confined and unconfined explosives have different values and are known as upper and lower detonation velocities respectively.

The VOD of an organic explosive is also a function of the energy produced by its decomposition and therefore, a relationship has been derived between detonation properties of an explosive and its chemical constitution.

Assignment to text B. Read text B again and write out the words in black type. Give the meanings of these terms. (You may use the Glossary of Terms at the end of this book).

Pre-text Exercises to Text C

1. Read the words using transcriptions. Guess about their meanings:

consequently ['kOnsIkwqntlI], **until**[An'tIl], **subsonic** [sAb'sOnIk], **supersonic** ["sHpq'sOnIk], **muzzle** [mAzl], **behind** [bI'haInd], **mining** ['maInIN], **rupture** ['rApCq], **amount** [q'maunt], **firearms** ['faIqr'Rmz], **fireworks** ['faIq"wWks], **suitable** ['sHtqbl], **brisance** ['brJzqns], **burn** [bWn], **nitro-explosives** ['naItrqu Ik'splqusIv], **potassium** [pq'txsIqm], **warhead** ['wL"hed], **fortifications** ["fLtIfI'keISqn], **roughly** ['rAflI], **incendiaries** [In'sendIqrIz], **searching** [sWCIN], **purification** ['pjuqrIfI"keISn], **appease** [q'pJz]

2. Translate the following words. Refer to the transcriptions in exercise 1 for correct pronunciation.
следовательно, до тех пор пока не, дозвуковой, сверхзвуковой, дуло, позади, горнорудный, разрывать, количество, огнестрельное оружие, фейерверки, подходящий, бризантность, гореть, нитро-взрывчатые вещества, калий, боеголовка, укрепления, приблизительно, зажигательные средства, поиск, очистка, умиротворять

3. Read the lexical program of text B. Try to memorize it.

(1) the first chemical explosive	(1) первое химическое взрывчатое вещество
(2) the only one known until the mid-1800s	(2) единственное известное взрывчатое вещество до середины 1800 годов
(3) a mixture of sulphur, charcoal, and potassium nitrate (saltpetre)	(3) смесь серы, древесного угля и нитрата калия (селитры)
(4) with the sulfur and charcoal acting as fuels	(4) с серой и древесным углем, действующими в качестве топлива
(5) saltpetre works as an oxidizer	(5) селитра работает в качестве окислителя

(6)because of its relatively slow decomposition rate and consequently low brisance	(6) из-за его относительно медленной скорости разложения и, следовательно, низкой бризантности
(7) the powder packed behind a bullet	(7) порох, помещенный сзади пули
(8) Gunpowder was widely used to fill artillery shells	(8) Порох широко использовался как наполнитель артиллерийских снарядов
(9) main explosive in mining operations	(9) основное взрывчатое вещество, применяемое при добыче полезных ископаемых
(10). according to prevailing academic consensus	(10) в соответствии с преобладающим мнением академической среды

Text C. History of Gunpowder

Gunpowder, also known since the late 19th century as **black powder**, was the first chemical explosive and the only one known until the mid-1800s. It is a mixture of sulphur, charcoal, and potassium nitrate (saltpetre) - with the sulfur and charcoal acting as fuels, while the saltpetre works as an oxidizer. Because of its burning properties and the amount of heat and gas volume that it generates, gunpowder has been widely used as a propellant in firearms and as a pyrotechnic composition in fireworks.

Gunpowder is classified as low explosive because of its relatively slow decomposition rate and consequently low brisance. Low explosives deflagrate (i.e., burn) at subsonic speeds, whereas high explosives detonate, producing a supersonic wave. Ignition of the powder packed behind a bullet must generate enough pressure to force it from the muzzle at high speed, but not enough to rupture the gun barrel. Gunpowder thus makes a good propellant, but is less suitable for shattering rock or fortifications. Gunpowder was widely used to fill artillery shells and in mining and civil engineering to blast rock roughly until the second half of the 19th century, when the first high explosives (nitro-explosives) were discovered. Gunpowder is no longer used in modern explosive military warheads, nor is it used as main explosive in mining operations due to its cost relative to that of newer alternatives such as ammonium nitrate/fuel oil (ANFO).

Gunpowder was, according to prevailing academic consensus, discovered in the 7th century in China, attributed to Chinese alchemists searching for an elixir of immortality. The earliest record of a written formula for gunpowder appears in the 11th century.

The Arabs acquired knowledge of gunpowder sometime between 1240 and 1280, by which time Hasan al-Rammah had written, in Arabic, recipes for gunpowder, instructions for the purification of saltpeter, and descriptions of gunpowder incendiaries. Gunpowder arrived in the Middle East, possibly through India, from China.

In Europe, one of the first mentions of gunpowder use appeased in Roger Bacon's *Opus Tertium* in which it was interpreted as being firecrackers.

Some useful words and phrases:

– since the late 19th century – с конца 19 века
– the only one known – единственный известный
– with the sulfur and charcoal acting as fuels – причем сера и древесный уголь действовали как топливо
– because of its burning properties – из-за его горючих свойств
– where as high explosives detonate – в то время как мощные взрывчатые вещества детонируют
– gunpowder has been widely used as a propellant– порох широко используется в качестве пропеллента
– bullet must generate enough pressure to force it from the muzzle – пуля должна генерировать достаточное давление, чтобы с силой вылететь из дула
– is no longer used – больше не используется
– gunpowder thus makes a good propellant – порох, таким образом, оказывается хорошим топливом
– relative to that of newer alternatives – относительно цены новых альтернатив
– due to its cost – вследствие его цены
– one of the first mentions of gunpowder – одно из первых упоминаний о порохе
– it was interpreted as being firecrackers – интерпретировались как петарды

Assignment to text C. Make parallel translation of the following sentences from text C (from English into Russian and vice versa). Try not to peep into the ready translation.

(1) Gunpowder, also known since the late 19th century as black powder, was the first chemical explosive.	(1) Порох, также известный с конца 19 века как черный порох, был первым химическим взрывчатым веществом.
(2) Gunpowder has been widely used as a propellant in firearms and as a pyrotechnic composition in fireworks.	(2) Порох широко используется в качестве топлива в огнестрельном оружии и в качестве пиротехнического состава в фейерверках.
(3) Gunpowder is classified as low explosive because of its relatively slow decomposition rate.	(3) Порох относится к категории маломощных взрывчатых веществ из-за его относительно медленной скорости разложения.
(4) Chinese alchemists searching for an elixir of immortality.	(4) Китайские алхимики, находящиеся в поиске эликсира бессмертия.
(5) The earliest record of a written formula for gunpowder appears in the 11th century.	(5) Самая ранняя запись о письменной формуле пороха появляется в 11 веке.
(6) Instructions for the purification of saltpeter, and descriptions of gunpowder incendiaries.	(6) Инструкции по очистке селитры и описания зажигательных средств пороха.

GUIDED REVIEW TO LESSON five

Assignment to Lesson five (1):

Choose the correct missing words in the chart below.

(1) The bulk charges (__________ explosives) in these munitions are _________ to some extent and are, therefore, safe for handling, storage and transportation.	**Secondary** **High** **Low** **insensitive** **sensitive**
(2) Military explosives must be __________ and chemically stable over a wide range of temperatures and humidity for a long period of time.	**physically** **commercially** **strategically**
(3)They must be reasonably insensitive to ________, such as those experienced by artillery shells when fired from a gun or when they penetrate steel armor.	**temperature** **pressure** **impacts**
(4) High temperature and pressure ____________ are generated in the wave front so that the chemical reaction is initiated instantaneously.	**rules** **requirements** **gradients** **promotion**
(5)The __________ detonation velocity of commercial explosives varies from 5000 to 25,000 fps.	**unconditional** **confined**
(6) Gunpowder thus makes a good __________, but is less suitable for shattering rock or fortifications.	**propellant** **assembly** **explosive**
(7) Gunpowder was widely used to fill artillery shells and in mining and civil engineering to blast rock roughly until the second half of the 19th century, when the first _________explosives (nitro-explosives) were discovered.	**high** **low** **intermediate** **distributed**
(8) The _________acquired knowledge of gunpowder sometime between 1240 and 1280, by which time Hasan al-Rammah had written, in ________, recipes for gunpowder, instructions for the purification of saltpeter, and descriptions of gunpowder incendiaries.	**Arabs** **Indians** **Chinese** **Arabic** **Russian**

Assignment to Lesson five (2):

Formulate and discuss with your class the problems put forward in Lesson five.

6. Lesson Six
DETONATION OF EXPLOSIVES

PROFESSIONAL TRAINING: Lesson six

Pre-text exercises to text A

1. Read the words using transcriptions. Guess about their meanings:

initiatory [I'nISI"qtqrI]**,** **fire** ['faIq], **spark** [spRk], **lead** [led], **azide** ['eIzaId], **percussion** [pq'kASqn],**mononitrotoluene**['mOnO'naItrqu'tOlju"Jn], **benchmark** ['benC"mRk], **ammonium nitrate** [q'mqunIqm 'nQItreIt], **ammonium perchlorate** [q'mqunIqm pq'klLreIt],**ammonium dinitramide** [q'mqunIqm dInaItr 'xmaId], **require** [rI'kwaIq], **mercury fulminate** ['mWkjurI 'fAlmI"neIt], **primers** ['praImqz], **weakness** ['wJknIs], **violence** ['vaIqlqns], **accidental** ["xksI'dentql], **likely** ['laIklI]

2. Translate the following words. Refer to the transcriptions in exercise 1 for correct pronunciation.
начальный, огонь, искра, свинец, азид, перкуссия, мононитротолуол, эталонный, аммиачная селитра, перхлорат аммония, динитрамид аммония, требовать, гремучая ртуть, праймеры, слабость, стремительность, случайный, вероятно

3. Read the lexical program of text A. Try to memorize it.

(1) primary or initiatory explosives; secondary explosives and tertiary explosives	(1) первичные или инициирующие взрывчатые вещества; вторичные и третичные взрывчатые вещества
(2) easily explode by the application of fire, spark, impact, friction etc	(2) легко взрывается от огня, искры, удара, трения и т.д.
(3) primary explosives are lead azide (LA), mercury fulminate (M), silver azide, basic lead azide (BLA) etc.	(3) первичные взрывчатые вещества это азид свинца (LA), гремучая ртуть (M), азид серебра, основной азид свинца (BLA) и др.
(4) used in primers, detonators and	(4) используются в праймерах,

percussion caps	детонаторах и капсюлях.
(5) deflagration - to - detonation transition	(5) переход от дефлаграции к детонации
(6) intermediate explosive booster	(6) промежуточный усилитель взрывчатого вещества
(7) high explosives require the use of a detonator	(7) бризантные взрывчатые вещества требуют использования детонатора
(8) require an intermediate explosive booster of secondary explosive	(8) требуется промежуточный усилитель взрывчатого вещества на основе вторичного взрывчатого вещества
(9) is considered a benchmark explosive	(9) считается эталоном взрывчатых веществ
(10) insensitive to both mechanical shock and flame	(10) нечувствительны как к механическим ударам, так и к пламени

Text A. High Explosives.

These explosives are characterized by very high rates of reaction and generation of high pressures on explosion. They are usually sub - divided into primary or initiatory explosives; secondary explosives and tertiary explosives.

Primary high explosives are very sensitive materials and are easily exploded by the application of fire, spark, impact, friction etc. They are dangerous to handle and are used in comparatively small quantities. They are generally used in primers, detonators and percussion caps. Examples of primary explosives are lead azide (LA), mercury fulminate (M), silver azide, basic lead azide (BLA) etc.

Secondary high explosives are explosives which are relatively insensitive to both mechanical shock and flame but explode with greater violence when set off by an explosive shock obtained by detonating a small amount of a primary explosive in contact with it. In other words, secondary high explosives require the use of a detonator and frequently a booster. PETN is often considered a benchmark explosive, with explosives that are more sensitive than PETN being classified as primary explosives.

A major difference between primary and secondary explosives arises from the fact that primary explosives are initiated to detonate by burning whereas all other parameters being equal, the faster the DDT (deflagration - to - detonation transition), the better the primary explosive. At the same time, fast DDT shows a weakness because accidental initiation of deflagration results in detonation.

Tertiary explosives (also called blasting agents) mainly consist of oxidizers such as ammonium nitrate (AN , NH 4 NO 3), ammonium perchlorate (AP,NH 4 ClO 4), ammonium dinitramide [ADN , NH 4 N (NO 2)2] and mononitrotoluene (MNT) etc. It is more difficult to initiate tertiary explosives by fire, impact or friction and, if initiated, they have a large critical diameter so that the propagation to mass detonation is much less likely than for secondary explosives. Tertiary explosives are so insensitive to shock that they cannot reliably be detonated by practical quantities of primary explosives and require an intermediate explosive booster of secondary explosive instead. These explosives, in pure form without fuel components, also have low explosion energies, only about a third of that of TNT.

Assignment to text A. Make a list of terms denoting high explosives. Add some more information about them (in writing).

Pre-text Exercises to Text B.

1. Read the words using transcriptions. Guess about their meanings:

wave [weIv]**,** **occur**[q'kW], **indicator** ["IndI'keItq], **magnitude** ['mxgnI"tjHd], **shape** [SeIp], **duration** [dju'reISqn], **crushing** ['krASIN], **brisant** ['brJzqnt], **cracking** ['krxkIN], **throwing** [TrquIN], **sensor** ['sensq], **propagate** ['prOpq"geIt], **velocity** [vI'lOsItI], **infinitesimally** ["InfInI'tesImqlI], **sonic** ['sOnIk], **supersonic** ['sHpq 'sOnIk], **subsonic** [sAb 'sOnIk], **release** [rI'lJs], **discontinuously** [dIskqn'tJnjqslI], **gradients** ['greIdIqnts], **computational** ["kOmpju'teISqnql], **sudden** ['sAdqn], **plane** [pleIn], **undisturbed** [An'dIstWbd], **rarefaction** ["rFqrI'fxkSqn]

2. Translate the following words. Refer to the transcriptions in exercise 1 for correct pronunciation.

волна, происходить, индикатор, величина, форма, продолжительность, дробление, бризантный, растрескивание, отбрасывание, датчик, распространяться, скорость, бесконечно, звуковой, сверхзвуковой, дозвуковой, высвобождение, прерывисто, градиенты, вычислительный, внезапный, плоскость, непотревоженный, разрежение

3. Read the lexical program of text B. Try to memorize it.

(1) When passing	(1) При прохождении
(2) effectiveness of the use of explosives	(2) Эффективность использования взрывчатых веществ
(3) The shape and magnitude of the useful work of explosion	(3) Форма и величина полезной работы взрыва
(4) the crushing (brisant) action of the explosion	(4) дробление (бризантное) действие взрыва
(5) the cracking and throwing (high-explosive) effect of the explosion	(5) растрескивание и отбрасывание (осколочно-фугасный) эффект взрыва
(6) a method using Manganin pressure sensors	(6) метод, использующий датчики давления Манганина
(7) detonation propagates at a velocity at which the reacting gases just reach sonic velocity	(7) детонация распространяется со скоростью, при которой реагирующие газы достигают скорости звука
(8) in the frame of the leading shock of the detonation wave	(8) в рамках главного удара детонационной волны
(9) the detonation wave increases the pressure stepwise	(9) детонационная волна дает ступенчатое увеличение давления
(10) The sonic plane forms a "choke point"	(10) В звуковой плоскости образуется «воздушная заслонка»

Text B. Fundamental Features of Explosives: Detonation Pressure

Detonation pressure is the pressure in front of the detonation wave in the **explosive charge**.

When passing, the detonation wave increases the pressure stepwise and for most explosives detonation pressure is from 50 to 260 kbar (5000-26000 MPa). Detonation pressure is an important indicator of the effectiveness of the use of explosives. The shape and magnitude of the useful work of explosion depend on its **magnitude and duration**. The higher the pressure of detonation, the higher is the crushing (brisant) action of the explosion. The higher the duration, the higher is the cracking and throwing (high-explosive) effect of the explosion.

There are a number of **computational methods** for calculating the detonation pressure. The development of such methods was connected with the names of L.D. Landau, K. Stanyukovich, etc.

Experimental methods were also developed for determining the detonation pressure, for example, a method using Manganin pressure sensors.

A shock wave that accompanies detonation and has a **shock front** followed by a region of decreasing pressure in which the reaction occurs.

The **Chapman – Jouguet condition** is used in relation to detonation waves in high explosives. It states that the detonation propagates at a velocity at which the reacting gases just reach **sonic velocity** (in the frame of the leading shock wave) as the reaction ceases.

Chapman and Jouguet originally (1900) stated the condition for an **infinitesimally thin detonation**. A physical interpretation of the condition is usually based on the later modelling (1943) by Zel'dovich, von Neumann and W. Döring (the so-called ZND detonation model.

In accordance with ZND model, in the frame of the leading shock of the detonation wave, gases enter at **supersonic velocity** and are compressed through the shock to a high-density, **subsonic flow**. This sudden change in pressure initiates the chemical (or sometimes, as in steam explosions, physical) energy release. The energy release re-accelerates the flow back to the local speed of sound. There would be discontinuously large **pressure gradients** at that point.

The sonic plane forms a "choke point" that enables the lead shock, and reaction zone, to travel at a constant velocity, undisturbed by the expansion of gases in the **rare faction region**.

Assignment to text B. Read text B again and write out the words in black type. Give the meanings of these terms.

Pre-text Exercises to Text C.

1. Read the words using transcriptions. Guess about their meanings:

coin [kOIn]**,** **distinguish** [dI'stINgwIS], **prior** ['praIq], **smokeless** ['smqukIIs], **semi-smokeless** [semI-'smqukIIs], **cordite** ['kLdaIt], **approximate** [q'prOksImIt], **smoke** [smquk], **difference** ['dIfqrqns], **chamber** ['CeImbq], **sharper** ['SRpq], **rupture** ['rApCq], **brownish** ['braunIS], **cease** [sJs], **potassium**[pq'txsIqm],

nitrate ['naItreIt], **supply** [sq'plaI], **simplify**['sImplI"faI], **fuel** [fjuql], **promote** [prq'mqut], **likelihood** ['laIklI"hud], **partially** ['pRSqlI], **pyrolyzed** ['paIrqu"laIzd], **cellulose** ['selju"lquz], **pure** [pjuq], **graphite** ['grxfaIt], **match head** [mxC hed], **adopted** [q'dOptId], **ratios** ['reISI"quz], **centuries** ['senCqrIz]

2. Translate the following words. Refer to the transcriptions in exercise 1 for correct pronunciation.

придумывать (создавать новые слова), различать, предшествовавший, бездымный, полу-бездымный, кордит, почти соответствовать, дым, различие, камера, более резкий, разорвать, коричневатый, прекращать, азотнокислый калий, снабжать, упростить,топливо,содействовать,вероятность,частично,пиролизованный, целлюлоза, чистый, графит, спичечная головка, принят, соотношения, столетия

3. Read the lexical program of text B. Try to memorize it.

(1) The term *black powder* was coined	(1) Термин черный порох был придуман
(2) to distinguish prior gunpowder formulations	(2) чтобы различать ранее известные составы пороха
(3) in cases where these are not referred to as cordite	(3) в случаях, когда они не называются кордитом
(4) Semi-smokeless powders featured bulk volume properties	(4) Полу-бездымный порох имеет свойства насыпного объема
(5) approximated black powder	(5) приближен к черному пороху
(6) the burn rate accelerates more rapidly	(6) скорость горения ускоряется быстрее
(7) making for a sharper rise in pressure	(7) приводя к более резкому подъему давления
(8) the bulk semi-smokeless powders ceased to be manufactured in the 1920s	(8) выпуск насыпных полу-бездымных порохов был прекращен в 20-е годы
(9) To reduce the likelihood of accidental ignition by static electricity	(9) Для снижения вероятности случайного возгорания из-за статического электричества
(10) prevents the build-up of electrostatic charge	(10) предотвращает накопление электростатического заряда

Text C. Composition and characteristics of black powder

The term *black powder* was coined in the late 19th century, primarily in the United States, to distinguish prior gunpowder formulations from the new smokeless powders and **semi-smokeless powders**, in cases where these are not referred to as **cordite**. Semi-smokeless powders featured **bulk volume properties** that approximated black powder, but had significantly reduced amounts of smoke and **combustion products**. One difference between them is that the older black powder burns at nearly the same rate in the open as when contained, while in smokeless powders the burn rate accelerates more rapidly within a closed chamber, making for a sharper rise in pressure which could rupture older weapons designed for black powder. Smokeless powders ranged in colour from brownish tan to yellow to white. Most of the bulk semi-smokeless powders ceased to be manufactured in the 1920s.

Black powder is a granular mixture of

- a nitrate, typically potassium nitrate (KNO_3), which supplies oxygen for the reaction;
- charcole, which provides carbon and other fuel for the reaction, simplified as carbon (C);
- sulfur (S), which, while also serving as a fuel, lowers the temperature required to ignite the mixture, thereby increasing the rate of combustion.

Potassium nitrate is the most important ingredient in terms of both bulk and function because the combustion process releases oxygen from the potassium nitrate, promoting the rapid burning of the other ingredients. To reduce the likelihood of **accidental ignition** by static electricity, the granules of modern black powder are typically coated with graphite, which prevents the build-up of **electrostatic charge**.

Charcoal does not consist of pure carbon; rather, it consists of partially pyrolyzed cellulose, in which the wood is not completely decomposed. Carbon differs from charcoal. Whereas charcoal's autoignition temperature is relatively low, carbon's is much greater. Thus, a black powder composition containing pure carbon would burn similarly to a match head, at best.

The current standard composition for the black powders that are manufactured by pyrotechnicians was adopted as long ago as 1780. Proportions by weight are 75% potassium nitrate (known as saltpeter), 15% softwood charcoal, and 10% sulfur. These ratios have varied over the centuries and by country, and can be altered somewhat depending on the purpose of the powder.

Some useful words and phrases:

– in cases where these are not referred to – в случаях, когда это не относится к…
– had significantly reduced amounts of smoke – значительно уменьшено количество дыма
– at nearly the same rate – почти стой же скоростью
– within a closed chamber – в закрытой камере
– in the open as when contained – в открытом виде и внутри
– making for a sharper rise– что дает более резкий рост
– ranged in colour – варьировались по цвету
– lowers the temperature required – понижает требуемую температуру
– while also serving as a fuel – а также и в качестве топлива
– in terms of both bulk and function – как сточки зрения объема, так и функции
– rather, it consists of partially pyrolyzed cellulose – скорее, он состоит из частично пиролизованной целлюлозы
– at best – в лучшем случае

Assignment to text C. **Make parallel translation of the following sentences from text C (from English into Russian and vice versa). Try not to peep into the ready translation.**

(1) Semi-smokeless powders featured bulk volume properties that approximated black powder, but had significantly reduced amounts of smoke and combustion products.	(1) Полубездымные пороха проявляют почти такие же объемные свойства (объем газообразных продуктов), что и черный порох, но выделяют значительно меньше дыма и продуктов горения.
(2) Potassium nitrate is the most important ingredient in terms of both bulk and function because the combustion process releases oxygen from the potassium nitrate, promoting the rapid burning of the other ingredients.	(2) Нитрат калия является наиболее важным элементом с точки зрения как объема, так и функции, поскольку в процессе горения выделяется кислород из нитрата калия, способствуя быстрому сжиганию других ингредиентов.
(3) To reduce the likelihood of accidental ignition by static electricity, the granules of modern black powder are typically coated with graphite, which prevents the build-up of electrostatic charge.	(3) Для снижения вероятности случайного возгорания из-за статического электричества, гранулы современного черного пороха, как правило, покрыты графитом, который предотвращает накопление электростатических зарядов.
(4) Whereas charcoal's autoignition temperature is relatively low, carbon's is much greater.	(4) В то время как температура самовоспламенения угля относительно низка, температура углерода намного выше.
(5) Thus, a black powder composition containing pure carbon would burn similarly to a match head, at best.	(5) Таким образом, черный порох, содержащий чистый углерод, будет гореть в лучшем случае так же, как спичечная головка.
(6) These ratios have varied over the centuries and by country, and can be altered somewhat depending on the purpose of the powder.	(6) Эти соотношения менялись на протяжении веков и в зависимости от стран, и могут быть несколько изменены в зависимости от целевого назначения пороха.

GUIDED REVIEW TO LESSON six

Assignment to Lesson six (1):

Choose the correct missing words in the chart below.

(1) A major difference between ________ and secondary explosives arises from the fact that primary explosives are initiated to detonate by ___________.	**secondary** **primary** **tertiary** **burning** **shock**
(2) Primary high explosives are ________ to handle and are used in comparatively small quantities.	**safe** **indifferent** **dangerous** **equipping**
(3) _________ explosives, in pure form without fuel components, also have low explosion energies, only about a third of that of TNT.	**eliminated** **prohibited** **secondary** **primary** **tertiary**
(4) When passing, the detonation wave increases the pressure __________ and for most explosives detonation pressure is from 50 to 260 kbar (5000-26000 MPa).	**stepwise** **gradually** **sharply**
(5) Detonation __________ is an important indicator of the effectiveness of the use of explosives.	**wave** **pressure** **temperature**
(6) There are a number of _________________ methods for calculating the detonation pressure.	**computational** **assembly** **experimenta**
(7) One difference between them is that the older black powder burns at nearly the same rate in the open as when contained, while in _____________ powders the burn rate accelerates more rapidly within a closed chamber, making for a sharper rise in pressure which could rupture older weapons designed for black powder.	**controllable** **smokeless** **distributed**
(8) Charcoal does not consist of pure carbon; rather, it consists of partially pyrolyzed __________, in which the wood is not completely decomposed.	**fuel** **cellulose** **composition**

окончание таблицы

(9)Thus, a black powder composition containing pure carbon would burn similarly to a __________, at best.	**match head** **charcoal**
(10) Semi-smokeless powders featured bulk volume properties that approximated black powder, but had significantly reduced amounts of smoke and __________ products.	**combustion** **by-** **waste** **sewage**
(11) To reduce the likelihood of **accidental** __________ by static electricity, the granules of modern black powder are typically coated with graphite.	**explosion** **ignition**

Assignment to Lesson six (2):

Formulate and discuss with your class the problems put forward in Lesson six.

7. Lesson seven

HIGH AND LOW EXPLOSIVES: DEFLAGRATION OR DETONATION

PROFESSIONAL TRAINING: Lesson seven

Pre-text exercises to text A

1. Read the words using transcriptions. Guess about their meanings:

detonation["detq'neISqn]**,** **ordinary** ['Ldqnqrɪ], **cast** [kRst],**faster** ['fRstq], **velocity** [vɪ'lOsɪtɪ], **sound** [saund],**combustible** [kqm'bAstɪbl], **lead azide** [led 'eɪzaɪd], **pentolite** ['pentqlaɪt], **burning** ['bWnɪN], **confinement** [kqn'faɪnmqnt], **weapons** ['wepqnz], **create** [krJ'eɪt], **situation** ["sɪtju'eɪSqn], **direction** [dɪ'rekSqn], **surface** ['sWfɪs], **speed**[spJd], **rate** [reɪt]

2. Translate the following words. Refer to the transcriptions in exercise 1 for correct pronunciation.

детонация, обыкновенный, литой, быстрее, скорость, звук, горючий, азид свинца, пентолит, горение, ограничение, оружие, создавать, ситуация, направление, поверхность, скорость

3. Read the lexical program of text A. Try to memorize it.

(1) partly determines its application	(1) частично определяет его применение
(2) ordinary cast TNT	(2) обыкновенный литой тротил
(3) many times faster	(3) во много раз быстрее
(4) the velocity of sound	(4) скорость звука
(5) in much the same manner	(5) во многом таким же образом
(6) ordinary combustible materials	(6) обычные горючие материалы
(7) speed of the deflagration	(7) скорость горения
(8) the products of burning	(8) продукты горения
(9) the degree of confinement	(9) степень ограничения
(10) area of the burning surface	(10) площадь поверхности горения

Text A. Detonation vs. Burning for High and Low Explosives

The rate of detonation of a high explosive is one of its important properties and partly determines its application. Ordinary cast TNT has a rate of detonation of about 7000 ms^{-1}; many times faster than the velocity of sound. The initiator lead azide has a rate of detonation of about 3800 ms^{1} whereas 50/50 pentolite has a rate of 7500 ms^{-1}.Low explosives burn much faster than ordinary combustible materials such as wood or paper, but in much the same manner. The direction of burning is also away from the point of initiation, but the products of burning may move in any direction away from the burning surface, and they do not create a low pressure situation, like in detonation.

The speed of the deflagration, or the rate of burning, depends upon many factors, such as the degree of confinement, area of the burning surface and composition of the low explosive. At the usual pressures existing in weapons, rate of burning is about 30 – 50 cm s^{-1}or about 1/10 000 of the rate of detonation of high explosives.

Most explosives may deflagrate or detonate and are used in high and low explosive compositions.

Assignment to text A. Comment on differences between detonation and burning. Add some more information about them (in writing).

Pre-text Exercises to Text B.

1. Read the words using transcriptions. Guess about their meanings:

power['pauq], **performance**[pq'fLmqns], **accomplish** [q'kAmplIS], **delivery** [dI'lIvqrI], **projection** [prq'GekSqn], **air blast** [FqblRst],**bubble energy** [bAbl enqGI], **strength** [streNT], **assess** [q'ses],**cylinder expansion** ['sIlIndq eks'pxnSqn], **radial** ['reIdIql],**sawdust pit** ['sL"dAst pIt], **transmit [**trxnz'mIt], **sustain** [sqs'teIn], **procedure** [prq'sJGq], **propagation** ['prOpq'geISqn], **hydrodynamic** ["haIdrqudaI'nxmIk], **predicting** ["prq'dIktIN], **imaginary** [I'mxGInqrI], **infinite** ['InfInIt]

2. Translate the following words. Refer to the transcriptions in exercise 1 for correct pronunciation.
мощность, производительность, осуществлять, доставка, прогнозирование, струи сжатого воздуха, энергия газового пузыря, сила, оценить, цилиндр расширения, радиальный, яма с опилками, передавать, поддерживать, процедура, распространение, гидродинамический, прогнозирование, мнимый, бесконечный

3. Read the lexical program of text B. Try to memorize it.

(1) ability to do work	(1) способность совершать работу
(2) ability to accomplish what is intended	(2) способность осуществлять задуманное
(3) in the way of energy delivery	(3) в отношении способа доставки энергии
(4) fragment projection	(4) прогнозирование образования фрагментов
(5) high-velocity jet	(5) высокоскоростная струя
(6) underwater shock	(6) подводная ударная волна
(7) tailored series of tests	(7) заданная серия испытаний
(8) to assess the material for its intended use	(8) чтобы оценить материал для использования по назначению
(9) derived from measurements of shock waves transmitted into water	(9) полученных с помощью измерений ударных волн, переданных в воду
(10) detonation wave propagation	(10) распространение детонационной волны

Text B. Fundamental Features of Explosives: Explosive Power or Strength

The term **power** or **performance** as applied to an explosive refers to its ability to do work. In practice, it is defined as the explosive's ability to accomplish what is intended in the way of **energy delivery** (i.e., fragment projection, **air blast,** high-velocity jet, underwater shock and bubble energy, etc.). Explosive power or strength is evaluated by a tailored series of tests to assess the material for its intended use.

Cylinder expansion. A standard amount of explosive is loaded into a long hollow cylinder, usually of copper, and detonated at one end. Data is collected concerning the rate of **radial expansion** of the cylinder and the maximum cylinder **wall velocity**.

Cylinder fragmentation. A standard steel cylinder is loaded with explosive and detonated in a sawdust pit. The fragments are collected and the size of **distribution** is analyzed.

Detonation pressure. Detonation pressure data are derived from measurements of shock waves transmitted into water by the detonation of cylindrical explosive charges of a standard size.

Determination of critical diameter. This test establishes the minimum physical size of a charge of a **specific explosive** that must sustain its own detonation wave. The procedure involves the detonation of a series of charges of different diameters until difficulty in detonation wave propagation is observed.

Infinite-diameter detonation velocity. Detonation velocity is dependent on **loading density**, **charge diameter**, and **grain size**. The hydrodynamic theory of detonation used in predicting explosive phenomena does not include the diameter of the charge, and therefore a detonation velocity, for an imaginary charge of infinite diameter. This procedure requires the firing of a series of charges of the same density and physical structure, but different diameters, and the extrapolation of the resulting detonation velocities to predict the detonation velocity of a charge of infinite diameter.

Assignment to text B. Read text B again and write out the words in black type. Give the meanings of these terms.

Pre-text Exercises to Text C.

1. Read the words using transcriptions. Guess about their meanings:

dry-compounded powder [draI kqm'paundId paudq]**,** **serpentine** ['sWpqn"taIn], **Satan** ['seItn], **ingredients** [In'grIdIqnt], **remixing** [rI'mIksIN], **hygroscopic** ["haIgrq'skOpIk], **fine** [faIn], **saltpeter** ["sLlt'pJtq], **humid** ['hjHmId], **major** ['meIGq], **hazard** ['hxzqd], **cannon** ['kxnqn], **loading** ['lqudIN], **Renaissance** [rq'neIsqns], **dvance** [qd'vRns], **neither nor**['nJDq nL], **compressed** [kqm'prest], **loose** [lHz], **tightly** [taItlI], **projectile** [prq'GektaIl],

touchhole ['tAC"hqul], **turbulence** ['tWbjulqns], **carefully** ['kFqfulI], **determine** [dI'tWmIn], **empty** ['emptI], **space** [speIs]

2. Translate the following words. Refer to the transcriptions in exercise 1 for correct pronunciation.

сухой компаундированный порох, змеевик, Сатана, ингредиенты, повторное смешивание, гидроскопический, мелкий, селитра, влажный, главный, опасность, пушка, загрузка, Ренессанс, продвижение, ни тот, ни другой, сжатый, рыхлый, плотно, снаряд, сенсорное отверстие, турбулентность, тщательно, определять, пустой, пространство

3. Read the lexical program of text B. Try to memorize it.

(1) common artillery piece	(1) обычный артиллерийский снаряд
(2) The ingredients were ground together with a mortar and pestle	(2) Ингредиенты измельчают вместе, используя ступку и пестик
(3) highly hygroscopic calcium nitrate	(3) высокая гигроскопичность нитрата кальция
(4) it was contaminated with highly hygroscopic calcium nitrate	(4) она была загрязнена высокогидроскопическим нитратом кальция
(5) in humid weather it would need to be redried	(5) в сырую погоду его необходимо будет снова высушить
(6) was filled only about half full	(6) заполнялся только наполовину
(7) a wooden bung pounded in to seal the chamber	(7) деревянную пробку забивают, чтобы запечатать камеру
(8) to seal the chamber from the barrel when assembled	(8) для герметизации камеры от ствола в собранном виде
(9) carefully determined empty space	(9) тщательно выбранное пустое пространство
(10) serpentine was used with older guns into the seventeenth century	(10) серпантин был использован с более старым оружием еще в семнадцатом веке

Text C. Serpentine

The original dry-compounded powder used in the fifteenth century Europe was known as "Serpentine", either a reference to Satan or to a common artillery piece that used it. The ingredients were ground together with a mortar and pestle, perhaps for 24 hours, resulting in a fine flour. Vibration during transportation could cause the components to separate again, requiring remixing in the field. Also if the quality of the saltpeter was low (for instance if it was contaminated with highly hygroscopic calcium nitrate), or if the powder was simply old (due to the mildly hygroscopic nature of potassium nitrate), in humid weather it would need to be redried. The dust from "repairing" powder in the field was a major hazard.

Loading cannon or bombards before the powdermaking advances of the Renaissance was a skilled art. Fine powder loaded haphazardly or too tightly would burn incompletely or too slowly. Typically, the breech-loading powder chamber in the rear of the piece was filled only about half full, the serpentine powder neither too compressed nor too loose, a wooden bung pounded in to seal the chamber from the barrel when assembled, and the projectile placed on that. A carefully determined empty space was necessary for the charge to burn effectively. When the cannon was fired through the touchhole, turbulence from the initial surface combustion caused the rest of the powder to be rapidly exposed to the flame.

The advent of much more powerful and easy to use corned powder changed this procedure, but serpentine was used with older guns into the seventeenth century.

Some useful words and phrases:

– could cause the components to separate – может вызвать отделение компонентов
– due to the mildly hygroscopic nature of potassium nitrate – вследствие со слабой гигроскопичностью нитрата калия
– when assembled – в собранном виде
– for the charge to burn effectively – чтобы снаряд сгорал эффективно
– a skilled art – квалифицированное искусство
– neither too compressed nor too loose – не слишком сжатый и не слишком рыхлый
– to be rapidly exposed to the flame – быстро подвергать воздействию пламени
– powder chamber in the rear of the piece – пороховая камера в задней части огневого средства

– would burn in completely or too slowly – сгорает не полностью, или слишком медленно

Assignment to text C. Make parallel translation of the following sentences from text C (from English into Russian and vice versa). Try not to peep into the ready translation.

(1) The ingredients were ground together with a mortar and pestle, perhaps for 24 hours, resulting in a fine flour.	(1) Ингредиенты измельчают вместе с помощью ступки и пестика, возможно в течение 24 часов до состояния мелкой муки.
(2) Vibration during transportation could cause the components to separate again, requiring remixing in the field.	(2) Вибрация во время транспортировки может снова вызвать разделение компонентов, что потребует повторного смешивания в полевых условиях.
(3) The dust from "repairing" powder in the field was a major hazard.	(3) Пыль от «ремонта» пороха в полевых условиях представляет наибольшую опасность.
(4) A carefully determined empty space was necessary for the charge to burn effectively.	(4) Тщательный выбор пустого пространства необходим для эффективного сжигания заряда.
(5) When the cannon was fired through the touchhole, turbulence from the initial surface combustion caused the rest of the powder to be rapidly exposed to the flame.	(5) Когда пушка выстреливала, турбуленция от первичного поверхностного сгорания заставляла остальной порох быстро воспламеняться.
(6) The advent of much more powerful and easy to use corned powder changed this procedure.	(6) Появление гораздо более мощного и простого в использовании гранулированного пороха изменило эту процедуру.

GUIDED REVIEW TO LESSON seven

Assignment to Lesson seven (1):

Choose the correct missing words in the chart below.

(1) The _______of detonation of a high explosive is one of its important properties and partly determines its application.	**size** **rate** **quality**
(2) The speed of the_______________, or the rate of burning, depends upon many factors, such as the degree of confinement, area of the burning surface and composition of the low explosive.	**deflagration** **providing** **organizing** **equipping**
(3) In practice, it is defined as the explosive's ability to accomplish what is intended in the way of _______delivery.	**eliminated** **explosive** **energy**
(4) Data is collected concerning the rate of radial _________ of the cylinder and the maximum cylinder wall velocity.	**suspend** **explosion** **expansion**
(5)A standard steel cylinder is loaded with ________ and detonated in a sawdust pit.	**explosive** **fuel**
(6) The procedure involves the detonation of a series of charges of different diameters until difficulty in detonation __________ propagation is observed.	**body** **wave** **explosive**
(7) A carefully determined empty _______ was necessary for the charge to burn effectively.	**fragments** **space**

Assignment to Lesson seven (2):

Formulate and discuss with your class the problems put forward in Lesson seven.

8. Lesson Eight
APPLICATIONS OF EXPLOSIVES

PROFESSIONAL TRAINING: Lesson eight

Pre-text exercises to text A

1. Read the words using transcriptions. Guess about their meanings:

innumerable [I'njHmqrqbl], **warfare** ['wLfFq], **explosive shells** [Iks'plquzIv Selz], **torpedo** [tL'pJdqu]**, missile warheads** ['mIsQll 'wL"hedz], **permissible** [pq'mIsqbl], **high-explosive cord** [haI Iksplquzlv kLd], **technologist** [tek'nOlqGIst], **Peace Prize** [pJs 'praIz]**, distinguish** [dI'stINgwIS]**, perhaps** [pq'hxps], **warlike purposes** ['wL"laIk'pWpqsIs], **illustrate** ['Ilq"streIt], **successfully** [sqk'sesfulI], **extinguish** [Ik'stINgwIS], **howitzer**['hauItsq]**, danger**['deInGq], **avalanche** ['xvq"lRnC], **iodide** ['aIq"daId], **promoting** [prq'mqutIN], **antiaircraft** [xntI'FqkrRft], **anti-hail** [xntI'heIl], **orchard crops** ['LCqd 'krOps], **avoid** [q'vOId], **disastrous** [dI'zRstqrqs]

2. Translate the following words. Refer to the transcriptions in exercise 1 for correct pronunciation.

неисчислимый, война, фугасные снаряды, торпеды, ракетные боеголовки, допустимый, фугасный шнур, технолог, Премия Мира, различать, возможно, военные цели, иллюстрировать, успешно, тушить, фугасный, опасность, лавина, йодид, содействие, зенитный, противоградовый, садовые культуры, избегать, гибельный

3. Read the lexical program of text A. Try to memorize it.

(1) The variety and number of explosives	(1) Разнообразие и количество взрывчатых веществ
(2) bombs, explosive shells, torpedoes, and missile warheads	(2) бомбы, фугасные снаряды, торпеды, и ракетные боеголовки
(3) Nondetonating explosives, e.g., gunpowder and the smokeless powders	(3)Не детонирующие взрывчатые вещества, например, порох и бездымные пороха

окончание таблицы

(4) extensive use as propellants for bullets and artillery shells	(4) широкое использование в качестве зарядов для пуль и артиллерийских снарядов
(5) either electrically or with a special high-explosive cord	(5) с помощью либо электричества, либо специальным фугасным шнуром
(6) Special explosives, called permissible explosives	(6) Специальные взрывчатые вещества, называемые допустимыми
(7) low cost and relative safety	(7) низкая стоимость и относительная безопасность
(8) is the last to want war	(8) не хочет войны
(9) modern explosives industry	(9) современная промышленность взрывчатых веществ
(10) was successfully extinguished with howitzer shells	(10) был успешно потушен снарядами гаубиц

Text A. Major Uses of Explosives

Today, the variety and number of explosives for various applications have become innumerable.

The major use of explosives has been in warfare. High explosives have been used in bombs, explosive shells, torpedoes, and missile warheads. Nondetonating explosives, e.g., gunpowder and the smokeless powders, have found extensive use as propellants for bullets and artillery shells.

The most important peaceful use of detonating explosives is to break rocks in mining. A hole is drilled in the rock and filled with any of a variety of high explosives; the high explosive is then detonated, either electrically or with a special high-explosive cord. Special explosives, called permissible explosives, must be used in coal mines. These explosives produce little or no flame and explode at low temperatures to prevent secondary explosions of mine gases and dust. One important explosive used in mining, called ANFO, is a mixture of ammonium nitrate and fuel oil. Its use has revolutionized certain aspects of open-pit and underground mining because of its low cost and relative safety.

The explosives technologist, who has usually seen and perhaps even experienced the effects of explosives, is the last to want war or to want his products to be used for warlike purposes. It is no accident that Nobel, who founded the modern explosives industry, also founded the Peace Prize associated with his name.

However, it is difficult to distinguish between military and peaceful applications of military weapons. Here are a few examples which illustrate that it is extremely difficult to classify them under military or civil applications.

- Gas burning from a newly drilled oil pit in Karlin in Northern Poland in 1981 was successfully extinguished with howitzer shells.
- The danger of an avalanche of snow can be prevented by firing special guns with shells filled with high explosives.
- Firing rockets with explosives loaded with silver iodide is in use for promoting rain. Silver iodide dispersed in higher layers of atmosphere by anti-aircraft rounds is in use during wars.
- Anti-hail rockets and anti-frost smoke have been reported for the protection of orchard crops to avoid the effects of disastrous weather conditions.

Assignment to text A. Read text A and make a list of major uses of explosives with your comments (in writing).

Pre-text Exercises to Text B.

1. Read the words using transcriptions. Guess about their meanings:

brisance[brizəns], **release**[rI'lJz], **consequence** ['kOnsIkwqns], **break** [breIk], **shatter** ['Sxtq], **upshot** ['Ap"SOt], **outcome** ['autkqm], **event** [I'vent], **fragmenting** ['frxgmentIN], **bomb casings** [bOm'keIsIN], **transmitted** [trqnz'mItId], **propagate** ['prOpq"geIt], **necessarily** ["nesI'serIlI], **Trauzl** [trLzl], **reference** ['refqrqns], **capacity** [kq'pxsItI], **gauge**[geIG], **require** [rI'kwaIq], **conventional** [kqn'venSqnl], **data** ['deItq], **originate** [q'rIGI"neIt], **lead** [led], **through** [TrH], **examine** [Ig'zxmIn], **hexogen**['heksq"Gen], **passage** ['pxsIG]

2. Translate the following words. Refer to the transcriptions in exercise 1 for correct pronunciation.

бризантность, освобождение, следствие, разрушение, разбивать, результат, последствие, событие, фрагментация, оболочки бомб, переданный, распространяться, обязательно, Трауцль, ссылка, емкость, калибровать, требовать, обычный, данные, происходить, свинец, через, исследовать, гексоген, прохождение

3. Read the lexical program of text B. Try to memorize it.

(1) the shattering or crushing effect of a sudden release of energy	(1) эффект раскалывания или дробления при внезапном выделении энергии
(2) the term originates from the French verb "briser"	(2) термин происходит от французского глагола "briser" ("разбивать, дробить")
(3) the effectiveness of an explosion	(3) эффективность взрыва
(4) the action of the transmitted shock wave	(4) действие переданной ударной волны
(5) the detonation wave propagates through the explosive	(5) детонационная волна распространяется по взрывчатке
(6) the strength of which depends on the detonation pressure of the explosive	(6) сила которого зависит от давления детонации взрывчатки
(7) explosive's total energy	(7) общая энергия взрывчатых веществ
(8) No single test is capable of directly comparing	(8) Ни один тест не в состоянии дать непосредственное сравнение
(9) Trauzl lead-block test	(9) бомба Трауцля для испытания взрывчатых веществ
(10) and so forth	(10) и так далее

Text B. Fundamental Features of Explosives: Brisance [brizəns]

Brisance is the shattering or crushing effect of a sudden release of energy as in an explosion consequence, effect, result, upshot, outcome, event.

Brisance is the **shattering capability** of a high explosive, determined mainly by its detonation pressure. The term originates from the French verb "briser", which means to "break" or "shatter". Brisance is of practical importance for determining the effectiveness of an explosion in **fragmenting shells**, **bomb casings**, **grenades**, structures, and the like.

Fragmentation occurs by the action of the **transmitted shock wave**, the strength of which depends on the detonation pressure of the explosive. Generally, the higher this pressure, the finer the fragments generated. High detonation pressure correlates with high detonation velocity, the speed at which the detonation wave propagates through the explosive, but not necessarily with the **explosive's total energy** (or work capacity), some of which may be released after passage of the detonation wave. A more brisant explosive, therefore, projects smaller fragments but not necessarily at a higher velocity than a less brisant one.

The **sand crush test** is commonly used to determine the relative brisance in comparison to TNT (which is considered a standard reference for many purposes). No single test is capable of directly comparing the explosive properties of two or more compounds; it is important to examine the data from several such tests (sand crush, **trauzl lead block test**, and so forth) in order **to gauge** relative brisance. True values for comparison require field experiments.

One of the most brisant of the conventional explosives is cyclotrimethylene trinitramine (also known as RDX or Hexogen).

Assignment to text B. Read text B again and write out the words in black type. Give the meanings of these terms. (You may use the Glossary of Terms at the end of this book).

Pre-text Exercises to Text C.

1. Read the words using transcriptions. Guess about their meanings:

designate ['dezIg"neIt], **compress** [kqm'pres], **coarse** [kLs], **density** ['densItI], **ranging** ['reInGIN], **grains** [greIns], **hexagonal** [hek'sxgqnql], **century** ['senCqrI], **screen** [skrJn], **minimize**['mInImaIz], **mesh** [meS], **alternatively** [Ll'tWnqtIvlI], **categorise** ['kxtqgqraIz], **sieve** ['sJv], **retain** [rI'teIn], **residue** ['rezI"djH], **fouling** ['faulIN], **maintaining** [meIn'teInIN], **volumetric** ["vOlju'metrIk], **charges** [CRGIs]

2. Translate the following words. Refer to the transcriptions in exercise 1 for correct pronunciation.

обозначать, сжимать, крупнозернистый, плотность, в диапазоне, зерна, шестиугольный, столетие, экран, минимизировать, ячейка, альтернативно, классифицировать, сито, удерживать, остаток, обрастание, сохранение, объемный, заряды

3. Read the lexical program of text B. Try to memorize it.

(1) modern black powder is first compressed into blocks	(1) современный порох сначала прессуют в блоки
(2) for artillery bore diameters	(2) для артиллерии с диаметром ствола
(3) for use during the American Civil War	(3) для использования во время Гражданской войны в США
(4) Other versions had grains the size of golf and tennis balls	(4) Другие версии имели зерна размером с мячи для гольфа и тенниса
(5) medium and smallbore arms	(5) оружие среднего и малого калибра
(6) main service gunpowders	(6) порох основного назначения
(7) may alternatively alternatively be categorized by mesh size	(7) альтернативно могут быть классифицированы по размеру ячейки
(8) sieve mesh size	(8) размер ячейки сита

Text C. Modern Types of Black Powder

The modern black powder is first compressed into blocks with a fixed density (1.7 g/cm³). In the United States, gunpowder grains were designated F (for fine) or C (for coarse). Grain diameter is decreased with a larger number of Fs and increased with a larger number of Cs, ranging from about 2 mm for 7F to 15 mm for 7C. Even larger grains were produced for artillery bore diameters greater than about 17 cm. The standard Du Pont *Mammoth* powder developed by Thomas Rodman and Lammot du Pont for use during the American Civil War had grains averaging 0.6 inches diameter, with edges rounded in a glazing barrel. Other versions had grains the size of golf and tennis balls for use in 20-inch (50-cm) Rodman guns. In 1875 DuPont introduced *Hexagonal* powder for large artillery. By 1882 German makers also produced hexagonal grained powders of a similar size for artillery.

By the late 19th century manufacturing focused on standard grades of black powder from Fg used in large bore rifles and shotguns, through FFg (medium and smallbore arms such as muskets and fusils), FFFg (smallbore rifles and pistols), and FFFFg (extreme small bore, short pistols). A coarser grade for use in military artillery was designated A-1. These grades were sorted on a system of screens with oversize retained on a mesh of 6 wires per inch, A-1 retained on 10 wires per inch, Fg retained on 14, FFg on 24, FFFg on 46, and FFFFg on 60. FFFFFg were usually reprocessed to minimize explosive dust hazards. In the United Kingdom, the main service gunpowders were classified RFG (rifle grained fine) with diameter of one or two millimeters and RLG (rifle grained large) for grain diameters between two and six millimeters. Gunpowder grains may alternatively be categorised by mesh size: the BSS sieve mesh size, being the smallest mesh size on which no grains were retained. Recognised grain sizes are Gunpowder G 7, G 20, G 40, and G 90.

In the US, modern gunpowder substitutes like Perodex, Triple Seven and Black Mag 3 pellets have been developed since the 1970s. These products, which should not be confused with smokeless powders, aim to produce less fouling (solid residue), while maintaining the traditional volumetric measurement system for charges. New cleaning products for black-powder guns have also been developed.

Some useful words and phrases:

– with a fixed density – с фиксированной плотностью
– had grains averaging 0.6 inches diameter – имели зерна со средним диаметром 0,6 дюйма
– By the late 19th century – К концу 19-го века
– hexagonal grained powders of a similar size – гексагональные зернистые пороха такого же размера
– used in large borerifles and shotguns – использовались в ружьях и винтовках с большим диаметром ствола
– standard grades of black powder – стандартные марки черного пороха
– to minimize explosive dust hazards – чтобы свести к минимуму опасность взрыва пыли
– a coarser grade for use in military artillery – более грубая марка для использования в военной артиллерии
– have been developed since the 1970s – разрабатываются с 70-х годов
– were usually reprocessed – как правило, перерабатывались
– Recognised grain sizes are – Признанные размеры зерен
– with oversize retained on a mesh of 6 wires per inch – с удержанием негабаритных зерен на сетке из 6 проводов на дюйм
– which should not be confused with smokeless powders – которые не следует путать с бездымными порохами
– modern gunpowder substitutes – современные заменители пороха

Assignment to text C. Make parallel translation of the following sentences from text C (from English into Russian and vice versa). Try not to peep into the ready translation.

(1) The modern black powder is first compressed into blocks with a fixed density.	(1) Современный черный порох сначала прессуют в блоки с фиксированной плотностью.
(2) Grain diameter is decreased with a larger number of Fs and increased with a larger number of Cs.	(2) Диаметр зерен уменьшается при большем количестве Fs и увеличивается при большем количестве Cs.
(3) Other versions had grains the size of golf and tennis balls for use in 20-inch (50-cm) Rodman guns.	(3) Другие марки имели зерна размером с мячи для гольфа и тенниса, которые использовались в 20-дюймовых (50 см) орудиях Родмана.
(4) Even larger grains were produced for artillery bore diameters greater than about 17 cm.	(4) Еще более крупные зерна были произведены для артиллерии диаметром ствола более 17 см.
(5) These grades were sorted on a system of screens with oversize retained on a mesh of 6 wires per inch,	(5) Эти сорта были отсортированы на системе сит, а негабаритные зерна удерживались на сите из 6 проводов на дюйм.
(6) These products, which should not be confused with smokeless powders, aim to produce less fouling (solid residue), while maintaining the traditional volumetric measurement system for charges.	(6) Эти продукты, которые не следует путать с бездымными порохами, должны производить меньше загрязнений (твердый остаток), сохраняя при этом традиционную систему объемных измерений зарядов.

GUIDED REVIEW TO LESSON eight

Assignment to Lesson eight (1):

Choose the correct missing words in the chart below.

(1)Today, the variety and number of explosives for various _________ have become innumerable.	**purposes** **rocks** **applications**
(2) ___________ explosives, e.g., gunpowder and the smokeless powders, have found extensive use as propellants for bullets and artillery shells.	**Nondetonating** **Detonating** **Compressed**
(3) ________ is the shattering or crushing effect of a sudden release of energy as in an explosion consequence, effect, result, upshot, outcome, event.	**Compressing** **Brisance**
(4) ______ occurs by the action of the transmitted shock wave, the strength of which depends on the detonation pressure of the explosive.	**Fragmentation** **Scattering** **Assembly**
(5) High detonation _______ correlates with high detonation velocity, the speed at which the detonation wave propagates through the explosive, but not necessarily with the explosive's total energy (or work capacity).	**sound** **wave** **vapour** **pressure**
(6) By 1882 German makers also produced _____ grained powders of a similar size for artillery.	**hexagonal** **octagonal**
(7)A more brisant explosive, therefore, projects smaller fragments but not necessarily at a higher _________ than a less brisant one.	**basis** **velocity** **temperature**
(8) By the late 19th century manufacturing focused on _________grades of black powder from Fg used in large bore rifles and shotguns, through FFg (medium and smallbore arms such as muskets and fusils), FFFg (smallbore rifles and pistols), and FFFFg (extreme small bore, short pistols).	**standard** **modern** **fine** **rough**

Assignment to Lesson eight (2):

Formulate and discuss with your class the problems put forward in Lesson eight.

9. GLOSSARY OF TERMS

Decomposition is the process by which organic substances are broken down into simpler forms of matter.

Deflagration is a term describing subsonic combustion propagating through heat transfer; hot burning material heats the next layer of cold material and ignites it.

Detonation involves a supersonic exothermic front accelerating through a medium that eventually drives a shock front propagating directly in front of it.

При быстром и сильном сжатии ВВ нагревается, в результате происходит химическая реакция, сопровождающаяся выделением большого количества энергии и образованием газообразных продуктов.

Образующиеся газообразные продукты производят резкий удар по соседним слоям ВВ. Эти слои в свою очередь сжимаются, в них также образуется ударная волна и происходит интенсивная химическая реакция.

Ударная волна распространяется по всей массе ВВ со скоростью, равной нескольким километрам в секунду. Скоростью распространения ударной волны во взрывчатом веществе определяется скорость взрыва.

Ударная волна имеет впереди резко очерченный фронт, на котором происходит сильное повышение давления и температуры. Непосредственно за фронтом волны происходит превращение ВВ в газообразные продукты и выделение энергии. Продукты взрыва не удаляются из зоны реакции, а движутся в направлении распространения процесса вслед за ударной волной.

Благодаря выделению энергии в процессе химической реакции и постоянному ее восполнению скорость распространения ударной волны во взрывчатом веществе может оставаться постоянной. Такое распространение взрыва называется детонацией ВВ, а волна — детонационной. Скорость детонации можно определить как скорость распространения ударной волны по заряду ВВ.

Детонация представляет собой наиболее совершенную форму взрыва, когда процесс протекает с постоянной и максимально возможной для данного ВВ скоростью.

Exotic explosive materials is a reactive substance that contains a great amount of potential energy that can produce an explosion.

Специальные заряды. Могут быть термостойкие, малочувствительные или не штатные, новые вещества. Используются для специальных целей.

Catalysis is the increase in rate of a chemical reaction due to the participation of a substance called a catalyst.

A **projectile** is any object projected into space by the exertion of a force. Although any object in motion through space may be referred to as a projectile, the term more commonly refers to a ranged weapon.

To **reinforce** (with) is to strengthen with some added piece, support, or material.

A **firearm** is a portable gun, being a barreled weapon that launches one or more projectiles often defined by the action of an explosive.

Mining is the extraction of valuable minerals or other geological materials from the earth from an orebody, lode, vein, seam, or reef, which forms the mineralized package of economic interest to the miner.

Civil engineering is a professional engineering discipline that deals with the design, construction, and maintenance of the physical and naturally built environment, including works like roads, bridges, canals, dams, and buildings.

Absorbent substance is a material having capacity or tendency to absorb another substance.

A **detonator** is a device used to trigger an explosive device. Detonators can be chemically, mechanically, or electrically initiated.

A **blasting cap** is a small sensitive primary explosive device generally used to detonate a larger, more powerful and less sensitive secondary explosive such as TNT, dynamite, or plastic explosive.

An **outburst** is the sudden and violent ejection of coal, gas and rock from a coal face and surrounding strata in an underground coal mine.

An **explosion** is a rapid increase in volume and release of energy in an extreme manner, usually with the generation of high temperatures and the release of gases.

Oxidation is the *loss* of electrons or an *increase* in oxidation state by a molecule, atom, or ion.

Smokeless powder is the name given to a number of propellants used in firearms and artillery which produce negligible smoke when fired, unlike black powder which they replaced.

Ethers are a class of organic compounds that contain an ether group — an oxygen atom connected to two alkyl or aryl groups — of general formula R–O–R'. A typical example is the solvent and anesthetic diethyl ether.

A **solvent** is a substance that dissolves a solute (a chemically different liquid, solid or gas), resulting in a solution. A solvent is usually a liquid but can also be a solid or a gas.

A **propellant** is a chemical used in the production of energy or pressurized gas that is subsequently used to create movement of a fluid or to generate propulsion of a vehicle, projectile, or other object. Common propellants are energetic materials and consist of a fuel like gasoline, jet fuel, rocket fuel, and an oxidizer.

Combustible substance is a substance that can be burned to provide heat or power.

Trinitrotoluene (**TNT**), or more specifically, 2, 4, 6-trinitrotoluene, is a chemical compound. This yellow-colored solid is sometimes used as a reagent in chemical synthesis, but it is best known as a useful explosive material with convenient handling properties.

Nitroglycerin (**NG**), also known as nitroglycerine, trinitroglycerin, trinitroglycerine, or nitro, is more correctly known as glyceryl trinitrate or more formally: 1, 2, 3-trinitroxypropane. It is a heavy, colorless, oily, explosive liquid.

Picric acid is the chemical compound formally called 2, 4, 6-trinitrophenol (TNP). This yellow crystalline solid is one of the most acidic phenols and is vinylogous to nitric acid.

Friction is the force resisting the relative motion of solid surfaces, fluid layers, and material elements sliding against each other.

In thermodynamics, the term **exothermic** describes a process or reaction that releases energy from the system, usually in the form of heat, but also in a form of light (e.g. a spark, flame, or flash), electricity (e.g. a battery), or sound (e.g. explosion heard when burning hydrogen).

A **silicate** is a compound containing an anionic silicon compound. The great majority of silicates are oxides.

Sulfur or **sulphur** is a chemical element with symbol **S** and atomic number 16. It is an abundant, multivalentnon-metal.

A **shock wave** is a type of propagating disturbance.

Black powder known since the late 19th century was the first chemical explosive and the only one known until the mid-1800s. It is a mixture of sulfur, charcoal, and potassium nitrate (saltpeter)—with the sulfur and charcoal acting as fuels, while the saltpeter works as an oxidizer.

Charcoal is a light black residue consisting of carbon, and any remaining ash, obtained by removing water and other volatile constituents from animal and vegetation substances.

Potassium nitrate is a chemical compound with the formula KNO_3. It is an ionic salt of potassium ions K^+ and nitrate ions NO_3^-.

Primary high explosives are very sensitive materials and are easily exploded by the application of fire, spark, impact, friction etc.

Secondary high explosives are explosives which are relatively insensitive to both mechanical shock and flame but explode with greater violence when set off by an explosive shock obtained by detonating a small amount of a primary explosive in contact with it.

Tertiary explosives (also called blasting agents) mainly consist of oxidizers such as ammonium nitrate (AN, NH 4 NO 3), ammonium perchlorate (AP, NH 4 ClO 4), ammonium dinitramide [ADN, NH 4 N (NO 2) 2] and mononitrotoluene (MNT), etc.

Chapman - Jouguet condition - Модель Чепмена-Жуге

Система двух уравнений (для прямой Михельсона и кривой Гюгонио) содержит три неизвестных (D, P и V), поэтому для определения скорости детонации D требуется дополнительное уравнение, которое невозможно получить только из термодинамических соображений. Поскольку детонационная волна устойчива, звуковые возмущения в продуктах не могут догонять фронт детонационной волны, иначе он будет разрушаться. Таким образом, скорость звука в продуктах детонации не может превышать скорость течения за фронтом детонационной волны.

На плоскости P, V прямая Михельсона и кривая Гюгонио могут пересекаться не более чем в двух точках. Чепмен и Жуге предположили, что скорость детонации определяется по условию касания прямой Михельсона и кривой Гюгонио для полностью прореагировавших продуктов (детонационной адиабаты). В этом случае прямая Михельсона является касательной к детонационной адиабате, и эти линии пересекаются ровно в одной точке, названной точкой Чепмена-Жуге (CJ). Это условие соответствует минимальному наклону прямой Михельсона и физически означает, что детонационная волна распространяется с минимально возможной скоростью, и скорость течения за фронтом детонационной волны в точности равна скорости звука в продуктах детонации.

Cordite is a family of smokeless propellants developed and produced in the United Kingdom from 1889 to replace gunpowder as a military propellant.

Deflagration is a term describing subsonic combustion propagating through heat transfer; hot burning material heats the next layer of cold material and ignites it.

High explosive is an explosive, such as TNT, that combusts nearly instantaneously, thereby producing a violent, shattering effect.

10.VOCABULARY

Text A. Black Powder: The First Explosive.

projectile – снаряд
to reinforce (with) – укреплять, подкреплять, усиливать
arrow – стрела, указатель
firearm – (ручное) стрелковое оружие, огнестрельное оружие
boring implement – бурильное оборудование
fear of roof collapse – опасение обрушения кровли
mining – горные работы, разработка месторождения
civil engineering – строительное дело, гражданское строительство
unvarying composition – постоянные составляющие, неизменный состав

Text B. Invention of Dynamite

headache remedy – лекарство от головной боли
blasting – взрывной, дутьевой
to abandon – оставлять, забрасывать
obstacle – сложность, затруднение, неоднородность
safety – надежность, бесперебойность, безопасность
absorbent substance – абсорбированное вещество, абсорбат
inch – дюйм (1 inch=2.54 centimetres)
wrapper – обертка
to coat (with) – покрывать
moisture – влажность, влага, увлажнение
blow – взрыв, толчок, удар
to strike – зажигать
violence – интенсивность
to set off – взрываться, взрывать взрыв
detonator – воспламенить, взрыватель, взрывпатрон
blasting cap – капсюль, капсюль-детонатор
immense value – огромная ценность
pursuit – поиски, занятие
distress – бедствие

storm-beaten shores – потрепанные бурями берега
rough sea – бурное море, значительное волнение
boulder – булыжник, крупная галька
to blow out – прочищать, сдувать
stump – пень, обрубок, пенек
loosening soil – разрыхление почвы
explosive bonding – соединение с помощью взрыва, сварка методом взрыва
slab – большой слой породы, плита породы
to roll down – скатывать, прокатывать
slam – удар, толчок, шум
welded – заваренный, приваренный
stainless steel – нержавеющая сталь
grinding and polishing – шлифование и полировка

Text C. Alfred Bernhard Nobel – the Inventor of Dynamite.

armament manufacturer – изготовитель оружия
cannon and other armaments – пушки и другое вооружение
held 350 different patents– имел 350 различных патентов
posthumously– посмертно
in accordance to his will – в соответствии с его завещанием
in modern-day companies – в современных компаниях
in his turn – в свою очередь
at a young age – в молодом возрасте
diatomaceous earth – диатомит
more convenient to handle– более удобны в обращении
jelly-like substance – желеподобное (гелеобразное) вещество
gelignite (blasting gelatin) – гелигнит, гремучий студень, динамит
a host of similar combinations – множество подобных комбинаций
used in drilling and mining – используемые в бурении и добыче
off-shoot of this research – побочное исследование
precursor – предшественник

Text A. Definitions of Explosives

suitably triggered – подходит для приведения к действию механизма
to release – выпускать

rapid self-sustaining – быстрый самоподдерживающийся (реакции)
percussion – ударное действие, толчок
catalysis – катализ, автокатализ
to be liberated – быть высвобожденным, быть отпущенным
a sudden outburst of gases – внезапный выброс газов
to constitute explosion – создавать взрыв, приводить к взрыву
to point out – указывать, выделять, отмечать
insufficient rapidity – недостаточная скорость
coal yield – выход угля

Text B. Fundamental Features of Explosives: Compatibility and Stability; Oxygen Balance

compatibility – взаимозаменяемость, соответствие, совместимость
intimately – тщательно, глубоко, равномерно
incompatibility – невзаимно заменяемость, несовместимость
hazardous – рискованный, опасный, вредный
stringent storage and service requirements – строгое хранение и эксплуатационные требования
mutual compatibility – взаимная заменяемость, взаимная совместимость
interior surface coatings – слои внутренней поверхности
sealant, luting and potting composition – герметизирующий состав (уплотняющий состав), (временный) пломбировочный материал и герметизация (заливка)
assembly – сборочная единица
deterioration – повреждение, износ
oxidation – окисление
excess of oxygen – избыток кислорода
perfectly balanced – идеально сбалансированный

Text C. Paul Marie Eugène Vieill

to carry out – осуществлять, выносить, реализовывать
the theory of gunpowder combustion – теория горения пороха
undoubtedly – несомненно, безусловно
smokeless gunpowder – бездымный порох
utmost importance – крайне важно, первостепенное значение

a suitable solvent – подходящий растворитель
distilling off – отгонка, отгоняющий
fibrous wadding – волокнистая вата
stubborn – твердый, неподдающийся
to swell – набухать, увеличиваться в объеме, утолщаться
ether – эфир
desired proportion – желаемой (обозначенной) пропорции
solvent – растворитель, растворяющее средство
molded – опрессованный, отлитый в форме, формованный
grain configuration – форма заряда твёрдого ракетного топлива
flake – пластинка, чешуйка, топкий слой

Text A. Classification of Explosives

deflagrating – мгновенное сгорающий
to propel – побуждать, стимулировать
propellant – метательное ВВ, ракетное топливо
combustible substance – сгораемое вещество, горючее вещество
to undergo – испытывать, осуществлять, выполнять
shattering – дробление, разрушение, растрескивание
external source – источник энергии, внешний источник
trinitrotoluene – тринитротолуол (бризантное ВВ)
nitroglycerin – нитроглицерин (ВВ)
picric acid – пикриновая кислота(ВВ)
cyclonite – циклонит (ВВ)
blasting – буровзрывные работы, взрывные работы
to expand – расширять, развивать
sensitivity – чувствительность
tertiary – третичный, третьего порядка
to explode – взрывать, подрывать
military and civil applications - военное и гражданское применение
bond – связующее вещество

Text B. Fundamental Features of Explosives: Sensitivity and Sensitiveness; Heat of Formation

ease of initiation – простота инициирования
propagating capability – мощность распространения
customary – обычный, традиционный, привычный
converse – противоположное утверждение

synonymously – синонимично
impact – удар, толчок
friction – трение
shock – удар, импульс
spark – вспышка, искра
heat – подогрев, тепловое воздействие
constituent – составная часть, компонент
to absorb – амортизировать, поглощать
to give off – выделять, испускать, излучать
heat of formation – теплота образование, теплота соединения
to indicate – указывать, показывать
endothermic – эндотермический, теплопоглощающий
liberation of heat – выделение тепла, освобождение тепла
exothermic – экзотермический, химическая реакция с выделением тепла
to evolve – выделять, образовывать, выделяться, испускать
heat content – теплосодержание, теплотворная способность, теплота нагрева
net amount – активный запас

Text C. Civil Uses of Explosives.

mankind – человечество
to hack out – вырубать, вытёсывать
fort – крепость
to carve out – вырезать, создавать
chisel – резец, чекан
wedge – клин
to alleviate – облегчать, уменьшая
drudgery – тяжелая работа
destructive role – разрушительная роль, губительная роль
to tame – смирять, смягчать, делать покорным
hazardous terrain – опасная местность
overwhelming role – огромная роль
nutshell – ореховая скорлупа
to perceive – понимать, воспринимать
tremendous – огромный, гигантский
enormously – значительно
treatise – трактат, научный труд

Text A. Explosives in Civil Engineering

VOD (velocity of detonation) – скорость детонации
blasting or shattering effect – взрывной или бризантный (дробящий) эффект
obstacle – препятствие, затруднение
quarrying – разработка карьера
demolition work – взрывные работы
brick – кирпич
concrete – цемент
timber – древесина
slurry – жидкая глина, жидкая масса, жидкий бетон
pre-drilled holes – предварительно просверленные отверстия
boulder – булыжник, крупная галька
target – цель, производственное задание
silicate – силикат, соль или эфир кремнёвой или поликремнёвой кислоты
crack initiation – инициирование трещин, возникновение трещин
adverse effect – неблагоприятное влияние, противоположный эффект
densely – густота, плотность

Text B. Fundamental Features of Explosives: Heat of Explosion and Gases Evolved

oxidation reactions – реакции окисления
to release – выпускать, освобождать
adiabatic conditions – адиабатические условия (термодинамический процесс в макроскопической системе, при котором система не обменивается тепловой энергией с окружающим пространством)
work capacity – производительность, работоспособность
explosive – взрывчатое вещество, заряд
performance parameters – эксплуатационные параметры, рабочие характеристики
gaseous products – газообразные продукты
essential – необходимый
equilibrium constants – константы равновесия, константы химического равновесия
to measure – измерять

volume of gases – объем газов
standard temperature – стандартная температура
standard pressure - нормальное атмосферное давление
respectively – соответственно, в указанном порядке, относительно

Text C. Invention of Gunpowder.

saltpeter – калиевая селитра
sulphur – сера
charcoal – древесный уголь
incendiary and explosive projectiles – зажигательные (воспламенительные) и взрывные снаряды
weaponry – оружие, средства вооружения
troop – войска
cannons – орудия, артиллерия
barrel – ствол, труба, камера
outcome – результат, выход, конечный результат
merely – только, просто, лишь
curious – любопытный, любознательный
adjunct – помощник, адъютант,
longbow – большой лук (оружие), лук в рост стрелка
observation – результат наблюдения
make observation **-** сделать выводы по результатам, проделанной работы
to embrace – использовать (по максимуму)
assault – атака, нападение
craftsman – искусный мастер, мастер, умелец

Text A. Military Explosives

military explosives – военное взрывчатое вещество, боевое ВВ
to comprise – включать в себя
shell – снаряд (артиллерийский), мина
missile – метательный снаряд
rocket warhead – боевая головка ракеты
bulk charges – пространственный заряд, объемный заряд
munitions – военное снаряжение, боеприпасы
extent – величина, глубина
intermediate – полупродукт, промежуточная стадия,

промежуточный продукт
booster – вспомогательное устройство, вспомогательный детонатор, ускоритель (стартовый)
to penetrate – выжигать, перфорировать, проходить, проникать, пробивать
steel armor – стольная броня
aerial – воздушный, антенный
detonating – детонирующий, взрывчатый
deflagrating – мгновенное сгорающий (без детонации)

Text B. Fundamental Features of Explosives: Velocity of Detonation

shock wave – взрывная волна
detonation wave – детонационная волна
pressure gradient – перепад давления, градиент давления
constant speed – постоянная скорость, постоянная частота вращения
hydrodynamic theory – гидродинамическая теория
velocity – скорость, частота
density – концентрация, плотность, густота
confined – ограниченный
detonation velocity – скорость детонации
unconfined velocity – неограниченная скорость
cartridge – кассетный, пулеметный, патронный
to derive – получать, извлекать, происходить

Text C. History of Gunpowder

black powder – черный порох, дымный порох, черная взрывчатка
sulphur – сера
charcoal – древесный уголь
potassium nitrate – нитрат калия
low brisance – низкая бризантность
supersonic wave – сверхзвуковая волна
ignition – инициирование, запуск
bullet – пуля
muzzle – дуло
rupture – разрыв
shattering rock – раздробленная порода

fortifications - фортификационные сооружения

Text A. High Explosives.

primary/initiatory explosives – первичное ВВ, инициирующее ВВ
secondary explosives – вторичное ВВ, бризантное ВВ
quantity – количество
primer – средство воспламенения
percussion cap - ударный капсюль
insensitive – нечувствительный
violence – сила
equal – разный, одинаковый
oxidizers – окислители
reliably – надежно, верно, достоверно
to require – требовать, нуждаться
booster – усилитель, бустер, ракета-носитель
fuel component – горючий компонент (ракетного топлива), компонент топлива

Text B. Fundamental Features of Explosives: Detonation Pressure

fundamental features – основные черты
detonation pressure – давление взрывной волны, детонационное давление
detonation wave – волна детонации, взрывная волна
explosive charge – заряд ВВ, взрывной заряд
stepwise – поэтапно
magnitude and duration – величина (размер) и продолжительность
shock front – фронт ударной волны (взрыва)
Chapman–Jouguet condition- модель Чепмена-Жуге
sonic velocity – скорость, равная скорости звука; скорость звука, звуковая скорость
infinitesimally thin detonation – бесконечно слабая волна детонации
supersonic velocity – сверхзвуковая скорость
subsonic flow – дозвуковой поток, дозвуковое течение
sudden – внезапный, неожиданный
energy release – высвобождение энергии (при взрыве)Ю выход энергии взрыва, выделение энергии

to re-accelerate – повторно ускорять
discontinuously – прерывисто, разрывно, скачкообразно
pressure gradient – перепад давления, градиент давления
choke point – критический участок, слабое место
constant velocity – постоянная скорость
expansion – развитие, увеличение, расширение, распространение
rarefaction region – область разрежения (идет за детонационной волной)

Text C. Composition and characteristics of black powder

to refer – относиться, ссылаться, иметь отношение
cordite – кордит (название одного из видов нитроглицеринового бездымного пороха)
semi-smokeless powder – малодымный порох, полубездымный порох
to feature – показывать, изображать
bulk volume – суммарный объем, объем насыпного материала
to accelerate – ускорять, увеличивать скорость
to rupture – разрушать(ся), разрывать(ся)
combustion process – процесс горения, процесс сгорания
rapid burning – интенсивное горение
likelihood – вероятность, возможность
accidental ignition – непроизвольное воспламенение, случайное воспламенение
modern – современный, новый, усовершенствованный
to coat – покрывать
graphite – графит
build-up – наращивание, сосредоточение
electrostatic charge – статический (электростатический) заряд
rather – скорее, вернее, правильнее
whereas – в то время как, принимая во внимание, при этом, поскольку
to adopt – внедрить, выбрать, утверждать
to alter – изменять, менять, переделывать

Text A. Detonation vs. Burning for High and Low Explosives

rate – скорость, темп
partly determine – частично определять

ordinary – обычный, простой
combustible materials – горючие материалы, воспламеняемое вещество, горючее вещество
point of initiation – точка воспламенения
deflagration – дефлаграция, быстрое горение (сгорание без воспламенения)
degree of confinement – степень замкнутости (заряда ВВ, помещенного в зарядную камеру)

Text B. Fundamental Features of Explosives: Explosive Power or Strength

energy delivery – подача энергии, энергоснабжение
cylinder expansion – цилиндрическое распостранение, цилиндрическое развитие
radial expansion – радиальное распостранение
wall velocity – скорость (потока) у стенки
cylinder fragmentation – цилиндрический распад
distribution – рассредоточение, распространение
detonation pressure – давление взрывной волны, детонационное давление
to transmit – передавать, посылать, отправлять
determination of critical diameter – определение критического диаметра
specific explosive – особые ВВ (специального применения)
infinite-diameter detonation velocity – критический диаметр скорости детонации
loading density – плотность заряда, коэффициент заполнения
charge diameter – диаметр заряда
grain size – размер зерна
extrapolation – экстраполирование, распространение

Text C. Serpentine

artillery piece - артиллерийское орудие
saltpeter – нитрат калия
fine powder - мелкодисперсный порошок, мелкозернистый порох
breech-loading – заряжание с казенной части, заряжание с казны
powder chamber – зарядная камера, пороховая камера, патронник торпедного аппарата

Text A. Major Uses of Explosives

innumerable – бесчисленный, неисчислимый
warfare – война, борьба
high explosive – бризантное ВВ, взрывчатое вещество для горных работ
smokeless powder – бездымный порох
shell – снаряд
permissible explosive - предохранительное взрывчатое вещество, безопасное ВВ, разрешённое ВВ
to distinguish – различать, выделить
civil applications – использование в гражданских целях, гражданское применение
military applications - военное применение
to extinguish – тушить, гасить
oil pit - нефтяная скважина
avalanche – лавина, обвал
orchard crops - плодовая культура, огородная культура
disastrous – гибельный, катастрофический, разрушительный

Text B. Fundamental Features of Explosives: Brisance

brisance – бризантность (взрывчатых веществ), дробящая сила взрыва
shattering capability - сокрушительные возможности
fragmenting shells – расснаряжение, утилизация снаряда
bomb casing – оболочка снаряда
grenade – граната
transmitted shock wave – передаваемая ударная волна, посылаемая взрывная волна
explosive's total energy - общая энергия взрывчатых веществ. Энергия может выражаться разными показателями – бризантность, фугасность.
sand crush test – прочностное тестирование на разрушение
trauzl lead block test – тестирование бомбы Трауцля (для испытаний взрывчатых веществ)
to gauge – измерять, рассчитывать, оценивать, производить замер

Text C. Modern Types of Black Powder

to compress – сжимать, сдавливать, уплотнять
coarse – неочищенный, крупнозернистый
bore diameters – калибр ствола
edge- грань, ребро
standard grade – стандартный размер, стандартный сорт
rifle – орудие (винтовка, ружье)
shotgun - короткоствольное оружие
musket – огнестрельное оружие, мушкет
fusil – легкий мушкет
smallbore rifle – малокалиберное оружие
pistol – пистолет
coarser grade – грубая фракция
mesh –сито
wires – проволока
dust hazard – опасное пылевое воздействие, вредное действие пыли
mesh size – размер ячейки сита
fouling **-** образование (порохового) нагара
solid residue – сухой остаток

11.TEXTS FOR INDIVIDUAL WORK

Text 1. Gunpowder

Gunpowder, also known since the late 19th century as black powder, was the first chemical explosive and the only one known until the mid 1800s. It is a mixture of sulfur, charcoal, and potassium nitrate (saltpeter) - with the sulfur and charcoal acting as fuels, while the saltpeter works as an oxidizer. Because of its burning properties and the amount of heat and gas volume that it generates, gunpowder has been widely used as a propellant in firearms and as a pyrotechnic composition in fireworks.

Gunpowder was, according to prevailing academic consensus, discovered in the 9th century in China, attributed to Chinese alchemists searching for an elixir of immortality. This discovery led to the invention of fireworks and the earliest gunpowder weapons in China. In the centuries following the Chinese discovery, gunpowder weapons began appearing in the Arab world, Europe, and India. The consensus is that this was spread from China, through the Middle East, and then into Europe, although there remains some dispute over the amount of Chinese influence on later advancements in gunpowder technology.

Gunpowder is classified as a low explosive because of its relatively slow decomposition rate and consequently low brisance. Low explosives deflagrate at subsonic speeds, whereas high explosives detonate, producing a supersonic wave. Ignition of the powder packed behind a bullet must generate enough pressure to force it from the muzzle at high speed, but not enough to rupture the gun barrel. Gunpowder is thus less suitable for shattering rock or fortifications. Gunpowder was widely used to fill artillery shells and in mining and civil engineering to blast rock roughly until the 2nd half of the 19th century, when the first high explosives (nitro-explosives) were discovered. Gunpowder is no longer used in modern explosive military warheads, nor is it used as main explosive in mining operations due to its cost relative to that of newer alternatives like ANFO.

Gunpowder was invented, documented, and used in China where the Chinese military forces used gunpowder-based weapons technology (i.e. rockets, guns, cannon), and explosives (i.e. grenades and different types of bombs) against the Mongols when the Mongols attempted to invade and breach the Chinese city fortifications on the northern borders of China. After the Mongols conquered China and founded the Yuan Dynasty, they used the Chinese gunpowder-based weapons technology in their invasion of Japan; they also used gunpowder to fuel rockets.

The mainstream scholarly consensus is that gunpowder was invented in China, spread through the Middle East, and then into Europe, although there is a dispute over how much the Chinese advancements in gunpowder warfare influenced later advancements in the Middle East and Europe. The spread of gun powder across Asia from China is widely attributed to the Mongols. One of the first examples of Europeans encountering gunpowder and firearms is at the Battle of Mohi. At this battle the Mongols not only used gunpowder in early Chinese firearms but in the earliest grenades as well.

QUESTIONS

1. What’s the difference between gunpowder and black powder (if any)?
2. Where was gunpowder used following the Chinese discovery (countries, applications)?
3. How is gunpowder classified?
4. Why did gunpowder loose most of its applications nowadays?

Text 2. Early history of gunpowder.

A major problem confronting the study of the early history of gunpowder is ready access to sources close to the events described. Often enough, the first records potentially describing use of gunpowder in warfare were written several centuries after the fact, and may well have been colored by the contemporary experiences of the chronicler. It is also difficult to accurately translate original alchemy texts, especially medieval Chinese texts which employ metaphor to describe unexplained phenomena, into contemporary scientific language with its rigidly defined terminology. The difficulty in translation has given rise to errors or loose interpretations bordering on artistic licence.

Early writings potentially mentioning gunpowder are sometimes marked by a linguistic process where old words acquired new meanings. For instance, the Arabic word *naft* transitioned from denoting "naphta" to denoting "gunpowder", and the Chinese word *pao* evolved from meaning "catapult" to referring to "cannon". According to science and technology historian Bert S. Hall: "It goes without saying, however, that historians bent on special pleading, or simply with axes of their own to grind, can find rich material in these terminological thickets."

QUESTIONS

1. What makes the early history of gunpowder so difficult to study?
2. What causes "errors or loose interpretations" in understanding ancient texts? Could you give any examples?
3. Why does historian Bert S. Hall still sound optimistic?

Text 3. History of gunpowder: China.

Saltpeter was known to the Chinese by the mid-1st century AD and there is strong evidence of the use of saltpeter and sulfur in various largely medicinal combinations. A Chinese alchemical text dated 492 noted saltpeter burnt with a purple flame, providing a practical and reliable means of distinguishing it from other inorganic salts, thus enabling alchemists to evaluate and compare purification techniques; the earliest Arabic and Latin accounts of saltpeter purification are dated after 1200.

The first mention of a mixture resembling gunpowder appeared in Taishang Guaizu Danjing Mijue by Qing Xuzi; it describes mixing six parts sulfur to six parts saltpeter to one part birthwort herb (which would provide carbon). The first reference to the incendiary properties of such mixtures is the passage of the Zhenyuan miaodao yaolüe, a Taoist text tentatively dated to the mid-9th century AD: "Some have heated together sulfur, realgar and saltpeter with honey; smoke and flames result, so that their hands and faces have been burnt, and even the whole house where they were working burned down."

The Chinese word for "gunpowder" is Chinese: 火药/火藥; pinyin: huǒ yào /xuou yɑʊ/, which literally means "Fire Medicine"; however this name only came into use some centuries after the mixture's discovery. By the 9th century Taoist monks or alchemists searching for an elixir of immortality had serendipitously stumbled upon gunpowder. The Chinese wasted little time in applying gunpowder to the development of weapons, and in the centuries that followed, they produced a variety of gunpowder weapons, including flamethrowers, rockets, bombs, and land mines, before inventing guns as a projectile weapon.

The Chinese "Wu Ching Tsung Yao" (Complete Essentials from the Military Classics), written by Tseng Kung-Liang between 1040–1044, provides encyclopedia references to a variety of mixtures which included petrochemicals, as well as garlic and honey.

A slow match for flame throwing mechanisms using the siphon principle and for fireworks and rockets are mentioned. The mixture formulas in this book do not contain enough salpeter to create an explosive however; being limited to at most 50% saltpeter, they produce an incendiary. The Essentials was however written by a Song Dynasty court bureaucrat, and there's little evidence that it had any immediate impact on warfare; there is no mention of gunpowder use in the chronicles of the wars against the Tanguts in the eleventh century, and China was otherwise mostly at peace during this century. The first chronicled use of "fire spears" (or "fire lances") is at the siege of De'an in 1132.

QUESTIONS

1. What was the first application of saltpeter and sulphur in China?
2. When were the incendiary properties of the mixture first mentioned?
3. When and how did the Chinese alchemists discover gunpowder?
4. Name the gunpowder weapons, used in the medieval China.

Text 3. History of gunpowder: Middle East.

The Arabs acquired knowledge of gunpowder sometime between 1240 and 1280, by which time Hasan al-Rammah had written, in Arabic, recipes for gunpowder, instructions for the purification of saltpeter, and descriptions of gunpowder incendiaries. Gunpowder arrived in the Middle East, possibly through India, from China. This is implied by al-Rammah's usage of "terms that suggested he derived his knowledge from Chinese sources" and his references to saltpeter as "Chinese snow", fireworks as "Chinese flowers" and rockets as "Chinese arrows". However, because al-Rammah attributes his material to "his father and forefathers", al-Hassan argues that gunpowder became prevalent in Syria and Egypt by "the end of the twelfth century or the beginning of the thirteenth".

Al-Hassan claims that in the Battle of Ain Jalut of 1260, the Mamluks used against the Mongols in "the first cannon in history" gunpowder formula with near-identical ideal composition ratios for explosive gunpowder. Other historians urge caution regarding claims of Islamic firearms use in the 1204-1324 period as late medieval Arabic texts used the same word for gunpowder, naft, that they used for an earlier incendiary naptha. Khan claims that it was invading Mongols who introduced gunpowder to the Islamic world and cites Mamluk antagonism towards early musketeers in their infantry as an example of how gunpowder weapons were not always met with open acceptance in the Middle East. Similarly, the refusal of their Qizilbash forces to use firearms contributed to the Safavid rout at Chaldiran in 1514.

The earliest surviving documentary evidence for the use of the hand cannon, considered the oldest type of portable firearm and a forerunner of the handgun, are from several Arabic manuscripts dated to the 14th century. Al-Hassan argues that these are based on earlier originals and that they report hand-held cannons being used by the Mamluks at the Battle of Ain Jalut in 1260.

Hasan al-Rammah included 107 gunpowder recipes in his text al-Furusiyyah wa al-Manasib al-Harbiyya (The Book of Military Horsemanship and Ingenious War Devices), 22 of which are for rockets. If one takes the median of 17 of these 22 compositions for rockets (75% nitrates, 9.06% sulfur, and 15.94% carbon), it is nearly identical to the modern reported ideal gunpowder recipe of 75% potassium nitrate, 10% sulfur, and 15% carbon.

QUESTIONS

1. What are the evidences of the fact that knowledge of gunpowder came to the Middle East from China?
2. What was the role of the Mongols in spreading gunpowder in the Islamic world?
3. When did the first hand-held cannons appear in the Middle East?
4. Did the recipes of gunpowder, mentioned in the book by Hasan al-Rammah, vary from the modern reported ideal gunpowder recipe?

Text 4. History of gunpowder: Mainland Europe.

In Europe, one of first mentions of gunpowder use appears in a passage found in Roger Bacon's Opus Maius and Opus Tertium in what has been interpreted as being firecrackers. The most telling passage reads: "We have an example of these things (that act on the senses) in [the sound and fire of] that children's toy which is made in many [diverse] parts of the world; i.e. a device no bigger than one's thumb.From the violence of that salt called saltpetre [together with sulphur and willow charcoal, combined into a powder] so horrible a sound is made by the bursting of a thing so small, no more than a bit of parchment [containing it], that we find [the ear assaulted by a noise] exceeding the roar of strong thunder, and a flash brighter than the most brilliant lightning."

In early 20th century, British artillery officer Henry William Lovett Hime proposed that another work tentatively attributed to Bacon, Epistola de Secretis Operibus Artis et Naturae, et de Nullitate Magiae contained an encrypted formula for gunpowder. This claim has been disputed by historians of science including Lynn Thorndike, John Maxson Stillman and George Sarton and by Bacon's editor Robert Steele, both in terms of authenticity of the work, and with respect to the decryption method. In any case, the formula claimed to have been decrypted (7:5:5 saltpeter:charcoal:sulphur) is not useful for firearms use or even firecrackers, burning slowly and producing mostly smoke.

QUESTIONS

1. How did Roger Bacon describe "firecrackers"?What epithets and comparisons did he use to describe the sound and the flash made by gunpowder? What impressed you the most?
2. What was the formula for gunpowder encrypted in Bacon`s book "Epistola…"?

3. Was this formula good for making firecrackers and firearms, according to some historians?

Text 5. Cannon forged in 1667 at the Fortín de La Galera, Nueva Esparta, Venezuela.

The Liber Ignium, or Book of Fires, attributed to Marcus Graecus, is a collection of incendiary recipes, including some gunpowder recipes. Partington dates the gunpowder recipes to approximately 1300. One recipe for "flying fire" (ingis volatilis) involves saltpetre, sulfur, and colophonium, which, when inserted into a reed or hollow wood, "flies away suddenly and burns up everything." Another recipe, for artificial "thunder", specifies a mixture of one pound native sulfur, two pounds linden or willow charcoal, and six pounds of saltpeter. Another specifies a 1:3:9 ratio.

Some of the gunpowder recipes of De Mirabilibus Mundi of Albertus Magnus are identical to the recipes of the Liber Ignium, and according to Partington, "may have been taken from that work, rather than conversely." Partington suggests that some of the book may have been compiled by Albert's students, "but since it is found in thirteenth century manuscripts, it may well be by Albert." Albertus Magnus died in 1280.

A common German folk-tale is of the German priest/monk named Berthold Schwarz who independently invented gunpowder, thus earning it the German name Schwarzpulver or in English Schwarz's powder. Schwarz is also German for black so this folk-tale, while likely containing elements of truth, is considered problematic.

A major advance in manufacturing began in Europe in the late 14th century when the safety and thoroughness of incorporation was improved by wet grinding; liquid, such as distilled spirits or perhaps the urine of wine-drinking bishops was added during the grinding-together of the ingredients and the moist paste dried afterwards. (The principle of wet mixing to prevent the separation of dry ingredients, invented for gunpowder, is used today in the pharmaceutical industry.)

It was also discovered that if the paste was rolled into balls before drying the resulting gunpowder absorbed less water from the air during storage and traveled better. The balls were then crushed in a mortar by the gunner immediately before use, with the old problem of uneven particle size and packing causing unpredictable results.

If the right size particles were chosen, however, the result was a great improvement in power. Forming the damp paste into corn-sized clumps by hand or with the use of a sieve instead of larger balls produced a product after drying that loaded much better, as each tiny piece provided its own surrounding air space that allowed much more rapid combustion than a fine powder. This "corned" gunpowder was from 30% to 300% more powerful. An example is cited where 34 pounds of serpentine was needed to shoot a 47 pound ball, but only 18 pounds of corned powder. The optimum size of the grain depended on its use; larger for large cannon, finer for small arms.

Larger cast cannon were easily muzzle-loaded with corned powder using a long-handled ladle. Corned powder also retained the advantage of low moisture absorption, as even tiny grains still had much less surface area to attract water than a floury powder.

During this time, European manufacturers also began regularly purifying saltpeter, using wood ashes containing potassium carbonate to precipitate calcium from their dung liquor, and using ox blood, alum, and slices of turnip to clarify the solution.

The art of gunpowder-making and metal-smelting and casting for shot and cannon was closely held by skilled military tradesmen, who formed guilds which collected dues, tested apprentices, and gave pensions. "Fire workers" were also required to craft fireworks for celebrations of victory or peace. During the Renaissance, two European schools of pyrotechnic thought emerged, one in Italy and the other at Nuremberg, Germany.

The Italian school of pyrotechnics emphasized elaborate fireworks, and the German school stressed scientific advancement. Vannoccio Biringuccio, born in 1480, was a member of the guild Fraternita di Santa Barbara but broke with the tradition of secrecy by setting down everything he knew in a book titled De la pirotechnia, written in vernacular. The first printed book on either gunpowder or metalworking, it was published posthumously in 1540, with 9 editions over 138 years, and also reprinted by MIT Press in 1966. By the mid-17th century fireworks were used for entertainment on an unprecedented scale in Europe, being popular even at resorts and public gardens.

In 1774 Louis XVI ascended to the throne of France at age 20. After he discovered that France was not self-sufficient in gunpowder, a Gunpowder Administration was established; to head it, the lawyer Antoine Lavoisier was appointed. Although from a bourgeois family, after his degree in law Lavoisier became wealthy from a company set up to collect taxes for the Crown; this allowed him to pursue experimental natural science as a hobby.

Without access to cheap Indian saltpeter (controlled by the British), for hundreds of years France had relied on saltpetermen with royal warrants, the droit de fouille or "right to dig", to seize nitrous-containing soil and demolished walls of barnyards, without compensation to the owners.

This caused farmers, the wealthy, or entire villages to bribe the petermen and the associated bureaucracy to leave their buildings alone and the saltpeter uncollected. Lavoisier instituted a crash program to increase saltpeter production, revised (and later eliminated) the droit de fouille, researched best refining and powder manufacturing methods, instituted management and record-keeping, and established pricing that encouraged private investment in works.

Although saltpeter from new Prussian-style putrefaction works had not been produced yet (the process taking about 18 months), in only a year France had gunpowder to export. A chief beneficiary of this surplus was the American Revolution. By careful testing and adjusting the proportions and grinding time, powder from mills such as at Essonne outside Paris became the best in the world by 1788, and inexpensive.

QUESTIONS

1. What principle of gunpowder manufacturing in the medieval Europe was borrowed by the modern pharmaceutical industry?
2. What were the advantages of "corn-sized" gunpowder compared with that rolled into balls?
3. Do think that gunpowder-making in Europe was a respected deal?
4.What was the contribution of Antoine Lavoisier to the development of saltpeter production in France?
5. Did France manage to export its gunpowder?

Text 6. British Isles.

Gunpowder production in Britain appears to have started in the mid 14th century AD with the aim of supplying The English Crown. Records show that gunpowder was being made in England, in 1346, at the Tower of London; a powder house existed at the Tower in 1461; and in 1515 three King's gunpowder makers worked there. Gunpowder was also being made or stored at other Royal castles, such as Portchester.

By the early 14th century, according to N.J.G. Pounds's study The Medieval Castle in England and Wales, many English castles had been deserted and others were crumbling. Their military significance faded except on the borders. Gunpowder had made smaller castles useless.

Henry VIII of England was short of gunpowder when he invaded France in 1544 AD and England needed to import gunpowder via the port of Antwerp.

The English Civil War, 1642–1645, led to an expansion of the gunpowder industry, with the repeal of the Royal Patent in August 1641.Two British physicists, Andrew Noble and Frederick Abel, worked to improve the properties of blackpowder during the late 19th century. This formed the basis for the Noble-Abel gas equation for internal ballistics.

The introduction of smokeless powder in the late 19th century led to a contraction of the gunpowder industry. After the end of World War I, the majority of the United Kingdom gunpowder manufacturers merged into a single company, "Explosives Trades limited"; and number of sites were closed down, including those in Ireland. This company became Nobel Industries Limited; and in 1926 became a founding member of Imperial Chemical Industries. The Home Office removed gunpowder from its list of Permitted Explosives; and shortly afterwards, on 31 December 1931, the former Curtis & Harvey's Glynneath gunpowder factory at Pontneddfechan, in Wales, closed down, and it was demolished by fire in 1932.

QUESTIONS

1. Where did the gunpowder production in Britain start?
2. What were the centers of gunpowder manufacturing?
3. What influenced the contraction of the gunpowder industry in the late 19th century?
4. What led to the end of the gunpowder manufacturing in Britain in the 20th century?

Text 7. Gunpowder manufacturing technology.

For the most powerful black powder meal, a wood charcoal is used. The best wood for the purpose is Pacific willow, but others such as alder or buckthorn can be used. In Great Britain between the 15th to 19th centuries charcoal from alder buckthorn was greatly prized for gunpowder manufacture; cottonwood was used by the American Confederate States. The ingredients are reduced in particle size and mixed as intimately as possible. Originally this was with a mortar-and-pestle or a similarly-operating stamping-mill, using copper, bronze or other non-sparking materials, until surplanted by the rotating ball mill principle with non-sparking bronze or lead. Historically, a marble or limestone edge runner mill, running on a limestone bed was used in Great Britain; however, by the mid 19th century AD this had changed to either an iron shod stone wheel or a cast iron wheel running on an iron bed. The mix was dampened with alcohol or water during grinding to prevent accidental ignition.

Around the late 14th century AD, European powdermakers first began adding liquid during grinding to improve mixing, reduce dust, and with it the risk of explosion. The powdermakers would then shape the resulting paste of dampened gunpowder, known as mill cake, into corns, or grains, to dry. Not only did corned powder keep better because of its reduced surface area, gunners also found that it was more powerful and easier to load into guns. Before long, powdermakers standardized the process by forcing mill cake through sieves instead of corning powder by hand.

The improvement was based on having a reduced surface area of a higher density composition. At the beginning of the 19th century, density was increased further by static pressing. Shoveling the damp mill cake into a two-foot square box, this was placed beneath a screw press and reduced to 1/2 its volume. "Presscake" had the hardness of slate; the dried slabs were then broken with hammers or with rollers, and the granules sorted with sieves into different grades. In the United States, Irenee du Pont, who had learned the trade from Lavoisier, tumbled the dried grains in rotating barrels to round the edges and increase its durability during shipping and handling.

Another advance was the manufacture of kiln charcoal by distilling wood in heated iron retorts instead of burning it in earthern pits; controlling the temperature influenced the power and consistency of the finished gunpowder. In 1863, in response to high prices for Indian saltpeter, DuPont chemists developed a process using potash or mined potassium chloride to convert plentiful Chilean sodium nitrate to potassium nitrate.

During the 18th century gunpowder factories became increasingly dependent on mechanical energy. Despite mechanization, production difficulties related to humidity control, especially during the pressing, were still present in the late 19th century. A paper from 1885 laments that "Gunpowder is such a nervous and sensitive spirit that in almost every process of manufacture it changes under our hands as the weather changes." Pressing times to the desired density could vary by factor of three depending on the atmospheric humidity.

QUESTIONS

1. What wood was mostly used in Great Britain and the USA for producing charcoal?
2. What technologies were applied to reduce charcoal wood to particles?
3.What for did powdermakers add liquid during grinding?
4. What were the advantages of "presscake"?
5. What did DuPont chemists undertake to reduce expenses on Indian saltpeter?
6. Why was gunpowder considered to be "a nervous and sensitive spirit"?

Text 8. Black powder composition and characteristics.

The term **black powder** was coined in the late 19th century, primarily in the United States, to distinguish prior gunpowder formulations from the new smokeless powders and semi-smokeless powders, in cases where these are not referred to as cordite. Semi-smokeless powders featured bulk volume properties that approximated black powder, but had significantly reduced amounts of smoke and combustion products. One difference between them is that the older black powder burns at nearly the same rate in the open as when contained, while in smokeless powders the burn rate accelerates more rapidly within a closed chamber, making for a sharper rise in pressure which could rupture older weapons designed for black powder. Smokeless powders ranged in colour from brownish tan to yellow to white. Most of the bulk semi-smokeless powders ceased to be manufactured in the 1920s.

Black powder is a granular mixture of a nitrate, typically potassium nitrate (KNO3), which supplies oxygen for the reaction; charcoal, which provides carbon and other fuel for the reaction, simplified as carbon (C);sulfur (S), which, while also serving as a fuel, lowers the temperature required to ignite the mixture, thereby increasing the rate of combustion.

Potassium nitrate is the most important ingredient in terms of both bulk and function because the combustion process releases oxygen from the potassium nitrate, promoting the rapid burning of the other ingredients. To reduce the likelihood of accidental ignition by static electricity, the granules of modern black powder are typically coated with graphite, which prevents the build-up of electrostatic charge.

Charcoal does not consist of pure carbon; rather, it consists of partially pyrolyzed cellulose, in which the wood is not completely decomposed. Carbon differs from charcoal. Whereas charcoal's autoignition temperature is relatively low, carbon's is much greater. Thus, a black powder composition containing pure carbon would burn similarly to a match head, at best.

The current standard composition for the black powders that are manufactured by pyrotechnicians was adopted as long ago as 1780. Proportions by weight are 75% potassium nitrate (known as saltpeter or saltpetre), 15% softwood charcoal, and 10% sulfur. These ratios have varied over the centuries and by country, and can be altered somewhat depending on the purpose of the powder. For instance, power grades of black powder, unsuitable for use in firearms but adequate for blasting rock in quarrying operations, is called blasting powder rather than gunpowder with standard proportions of 70% nitrate, 14% charcoal, and 16% sulfur; blasting powder may be made with the cheaper sodium nitrate substituted for potassium nitrate and proportions may be as low as 40% nitrate, 30% charcoal, and 30% sulfur.

In 1857 Lamont DuPont solved the main problem when using cheaper sodium nitrate formulations when he patented DuPont "B" Blasting powder; after manufacturing grains from press-cake in the usual way, the powder was tumbled with graphite dust for 12 hours, forming a coating on each grain which in this case reduced its ability to pick up moisture.

French war powder in 1879 used the ratio 75% saltpetre, 12.5% charcoal, 12.5% sulfur. English war powder in 1879 used the ratio 75% saltpetre, 15% charcoal, 10% sulfur. The British Congreve rockets used 62.4% saltpeter, 23.2% charcoal and 14.4% sulfur, but the British Mark VII gunpowder was changed to 65% saltpeter, 20% charcoal and 15% sulfur.

The explanation for the wide variety in formulation relates to usage. Powder used for rocketry can use a slower burn rate since it will accelerate the projectile for a much longer period of time, whereas powders for use in weapons such as flintlocks, caplocks or matchlocks need a higher burn rate since they must accelerate the projectile in a much shorter distance. Cannons usually used lower burn rate powders because most would burst if higher burn rate powders are used.

QUESTIONS

1. Does black powder mean the same as gunpowder?
2. What is the difference between black powder and smokeless powders?

3. What are the ingredients of black powder and their current standard ratio?

4. What problem did Lamont DuPont solve by patenting "B" Blasting powder?

5. What are the types of black powder from the point of view of their function, usage? How do these types depend on the burn rate?

Text 9. Serpentine.

The original dry-compounded powder used in fifteenth century Europe was known as "Serpentine", either a reference to Satan or to a common artillery piece that used it. The ingredients were ground together with a mortar and pestle, perhaps for 24 hours, resulting in a fine flour. Vibration during transportation could cause the components to separate again, requiring remixing in the field. Also if the quality of the saltpeter was low (for instance if it was contaminated with highly hygroscopic calcium nitrate), or if the powder was simply old (due to the mildly hygroscopic nature of potassium nitrate), in humid weather it would need to be redried. The dust from "repairing" powder in the field was a major hazard.

Loading cannon or bombards before the powdermaking advances of the Renaissance was a skilled art. Fine powder loaded haphazardly or too tightly would burn incompletely or too slowly. Typically, the breech-loading powder chamber in the rear of the piece was filled only about half full, the serpentine powder neither too compressed nor too loose, a wooden bung pounded in to seal the chamber from the barrel when assembled, and the projectile placed on that. A carefully determined empty space was necessary for the charge to burn effectively. When the cannon was fired through the touchhole, turbulence from the initial surface combustion caused the rest of the powder to be rapidly exposed to the flame.

The advent of much more powerful and easy to use corned powder changed this procedure, but serpentine was used with older guns into the seventeenth century.

QUESTIONS

1. What is the meaning of "serpentine"? What is the origin of this term?

2. What problems did the transportation and storage of serpentinecause?

3. What were the requirements to load the powder into a cannon correctly?

Text 10. Corning.

In order for gunpowder to explode effectively, the combustible mixture needs to be reduced to the smallest possible particle sizes as intimately mixed with one another as possible. But once mixed, for better results in a gun it was discovered that the final product should be in the form of individual, dense, grains (originally the size of corn) which allow the fire to spread quickly from grain to grain, much as straw or twigs catches fire quicker than a pile of sawdust.

Primarily for safety reasons, size reduction and mixing is done while the ingredients are damp, usually with water. After 1800, instead of forming grains by hand or with sieves, the damp millcake was pressed in molds to increase its density and extract the liquid, forming presscake. The pressing took varying amounts of time, depending on conditions such as atmospheric humidity. The hard, dense product was then broken again into tiny pieces which were separated with sieves to have a uniform product for each purpose; coarse powders were used for cannons, finer grained powders for muskets, and the finest for small hand guns and priming.

Inappropriately fine-grained powder often caused cannons to burst before the projectile could move down the barrel, due to the high initial spike in pressure. Mammoth powder with large grains made for Rodman's 15-inch cannon reduced the pressure to only 20 percent as high as ordinary cannon powder would have produced. In the mid-nineteenth century, measurements were made determining that the burning rate within a grain of black powder (or a tightly packed mass) is about 0.20 fps, while the rate of ignition propagation from grain to grain is around 30 fps, over two orders of magnitude faster.

QUESTIONS

1. What was the effect of reducing gunpowder to the size of corns?
2. Why did the gunpowder ingredients undergo pressing?
3. What caused bursting of cannons?

Text 11. Sulfur-free gunpowder.

The development of smokeless powders, such as Cordite, in the late 19th century created the need for a spark-sensitive priming charge, such as gunpowder. However, the sulfur content of traditional gunpowders caused corrosion problems with Cordite Mk I and this led to the introduction of a range of sulfur-free gunpowders, of varying grain sizes. They typically contain 70.5 parts of saltpetre and 29.5 parts of charcoal. Like black powder, they were produced in different grain sizes. In United Kingdom, the finest grain was known as sulfur-free mealed powder (SMP). Coarser grains were numbered as sulfur-free gunpowder (SFG n): 'SFG 12', 'SFG 20', 'SFG 40' and 'SFG 90', for example; where the number represents the smallest BSS sieve mesh size on which no grains were retained.

The main purpose of sulfur in gunpowder is to decrease the ignition temperature. A sample reaction for sulfur-free gunpowder would be

$4\ KNO_3 + C_7H_8O \rightarrow 3\ K_2CO_3 + 4\ CO_2 + 2\ H_2O + 3\ N_2$.

Combustion characteristics

A simple, commonly cited, chemical equation for the combustion of black powder is

$2\ KNO_3 + S + 3\ C \rightarrow K_2S + N_2 + 3\ CO_2$.

A balanced, but still simplified, equation is

$10\ KNO_3 + 3\ S + 8\ C \rightarrow 2\ K_2CO_3 + 3\ K_2SO_4 + 6\ CO_2 + 5\ N_2$.

Although charcoal's chemical formula varies, it can be best summed up by its empirical formula: C_7H_4O.

An even more accurate equation of the decomposition of regular black powder with the use of sulfur can be described as:

$4\ KNO_3 + C_7H_4O + 2\ S \rightarrow 2\ K_2S + 4\ CO_2 + 3\ CO + 2\ H_2O + 2\ N_2$.

Black powder without the use of sulfur:

$6\ KNO_3 + C_7H_4O \rightarrow 3\ K_2CO_3 + CO_2 + 6\ CO + 2\ H_2O + 2\ N_2$.

The burning of gunpowder does not take place as a single reaction, however, and the byproducts are not easily predicted. One study's results showed that it produced (in order of descending quantities) 55.91% solid products: potassium carbonate, potassium sulfate, potassium sulfide, sulfur, potassium nitrate, potassium thiocyanate, carbon, ammonium carbonate and 42.98% gaseous products: carbon dioxide, nitrogen, carbon monoxide, hydrogen sulfide, hydrogen, methane, 1.11% water.

Black powder made with less-expensive and more plentiful sodium nitrate (in appropriate proportions) works just as well but is more hygroscopic than powders made from potassium nitrate - popularly known as saltpeter. Because corned black powder grains made with saltpeter are less affected by moisture in the air, they can be stored unsealed without degradation by humidity. Muzzleloaders have been known to fire after hanging on a wall for decades in a loaded state, provided they remained dry. By contrast, black powder made with sodium nitrate must be kept sealed to remain stable.

Gunpowder contains 3 megajoules per kilogram, and contains its own oxidant. For comparison, the energy density of TNT is 4.7 megajoules per kilogram, and the energy density of gasoline is 47.2 megajoules per kilogram. Gun powder is a low explosive and as such it cannot detonate; rather it deflagrates.

QUESTIONS

1. What is the role of sulfur in gunpowder?
2. What are possible byproducts of gunpowder burning?
3. What alternative ingredient of gunpowder possesses better characteristics for keeping (storage)?
4. Why is gunpowder not used for detonation?

12.TEXTS FOR WORKING IN THE INTERNET

The following texts are taken from the websites of the famous information agencies - Euronews and BBC. So you have the possibility to study the terms of «Energy intensive materials: explosives» and their usage in the frames of a relatively new genre for you - publicistics. Most of the texts are accompanied with report clips. Clicking on the site references to the articles below you can master your skills of auding and reading.

Bomb-proof textiles take off

http://www.euronews.com/2011/01/25/bomb-proof-textiles-take-off/

Aviation safety is a worldwide concern. European researchers want to prevent further catastrophes with the help of textiles tested in explosive ways. At a British research centre experiments are being conducted into the effects of bomb blasts.

Researchers have developed a textile container designed to prevent the effects of small bombs hidden inside luggage which is then carried in aircraft cargo holds.

Donato Zangani, coordinator of the “Fly-Bag” project explains: “In our first test we want to measure how effective our prototype is in containing the explosion and the fragments it will emit, along with the subsequent expansion of gases.”

“The container has been constructed with a combination of different layers of technical textiles,” said Donato Zangani. “Each has its own characteristics. Some textiles have been positioned in different places to withstand the penetration of fragments flying out during the explosion. Some other textiles have been designed to be able to expand in a controlled way so the container can stretch without tearing itself apart.

“Besides that, we have produced an internal coating with two aims. The first is to contain the gases generated during the explosion. The second is to strengthen the resistance of the whole structure, so that the coating becomes a sort of flexible composite inside the container.”

Damaged luggage is then taken out of the Fly-Bag and new baggage put inside for the next test in which the amount of explosive has been increased by 50 percent. But again the bag holds tight.

Civil engineer Tord Gustafsson describes the test: “The explosion inside the luggage raises the whole container up in the air. And then comes the (gas) pressure from the explosion and blows the container up. The luggage falls down again inside the container. And the air pressure that has blown up the container leaks out. A small fire starts inside the luggage. Some smoke comes out through the zip. But this will just be for a very short while because inside the bag there is almost no oxygen, so the luggage is not burning for long at all.”

Researchers say the successful testing is a first step to ensuring that bomb-proof textiles could soon really improve aviation safety in our increasingly crowded skies.

Comet headed to Mars in 2014, impact possible

http://www.euronews.com/2013/03/05/xyz-comet-headed-to-mars-in-2014-impact-possible/

Asteroid hunters and astronomers have recently discovered a comet, named C/2013 A1 (Siding Spring), which is expected to whizz past Mars in October 2014.

According to calculations by the Catalina Sky Survey based at the University of Arizona, it could miss the Red Planet by a mere 100,000 kilometres. On the intergalactic scale, 100,000 kms is a very close shave.

Given the short distance, Mars could even pass right through the cloud of gas and material – or coma – around the core, or nucleus, of the comet which is thought to be several hundred kilometres across. As a result, Mars would be bombarded by debris from the coma of C/2013 A1, creating heavy meteor showers.

It is possible, albeit highly unlikely, that the orbit of the nucleus may be changed enough for it to cross Mars' path and hit the planet. The consequences would be dramatic: the nucleus is estimated to be between 15km to 50km wide, and impact with the Red Planet could reach a speed of about 55km/s (more than 193,000 km per hour).

According to a rough calculation, it could be an explosive yield of roughly one million billion tons of TNT exploding, an explosion about 25 million times larger than the largest nuclear weapon ever tested on Earth. And it could be an intergalactic firework show that is out of this world.

Croatia researchers work on getting honey bees to hunt for landmines

http://www.euronews.com/2013/05/23/croatia-researchers-work-on-getting-honey-bees-to-hunt-for-landmines/

Croatian officials estimate that since the beginning of the Balkan Wars in 1991, 2,500 people have been killed by landmines. During the four-year conflict, 90,000 landmines were randomly planted all over the country.

Zagreb University has been working on a technique to find unexploded landmines using bees. The honey-making winged insects are trained to find TNT, or trinitrotoluene, a powerful explosive mix.

"The experiment is to condition our bees on the smell of TNT. We put the reward in the centre of this scent. We use a sugar solution as a reward to condition the bees that they can find food just in the middle of the TNT scent," explained Zagreb University professor Nikola Kezic.

The idea is that the bees' keen sense of smell soon associates the smell of explosives with the scent of food.

So far, the technique has proved successful, but the problem is in training a colony of thousands of bees. Developers hope to master this, eventually providing a cheap and easily available resource for de-mining teams all over the Balkans.

"Pipe organ" plays above the Sun

http://news.bbc.co.uk/go/pr/fr/-/2/hi/science/nature/6574059.stm

Solar explosions called micro-flares generate sound booms which are then propagated along the coronal loops.

These "coronal loops" carry acoustic waves in much the same way that sound is carried through a pipe organ.

The corona is an atmosphere of hot, electrically-charged gas - or plasma - that surrounds the Sun. The temperature of the corona should drop the further one moves from the Sun.

But, in fact, the coronal temperature is up to 300 times hotter than the Sun's visible surface, or photosphere. And no one can explain why.

Solar explosions can release energy equivalent to millions of hydrogen bombs.

These blasts can send immensely powerful acoustic waves hurtling through the loops at tens of kilometres per second, creating cosmic "organ music".

Studying how plasma was heated to such high temperatures in coronal loops could speed up the technological development of industrial-scale nuclear fusion on Earth.

Nuclear fusion is the same process which powers the Sun and other stars. Unlike the burning of fossil fuels, fusion reactions produce no carbon dioxide, the greenhouse gas blamed by scientists for warming the planet.

Fusion works on the principle that energy can be released by forcing together atomic nuclei rather than by splitting them, as in the case of the fission reactions that drive existing nuclear power stations.

Russia loses $200 mln satellites as launch ends in flames

http://www.euronews.com/2013/07/02/russian-rocket-crashes-after-launch-in-baikonur-video/

A Russian rocket carrying three navigation satellites worth around $200 million crashed shortly after lift-off from the Russian-leased Baikonur launch facility in Kazakhstan after its engines suddenly switched off.

The accident led to a large spill of heptyl, a highly toxic rocket propellant, but there were no reports of casualties or of any immediate threat to nearby settlements.

The rocket contained 172 tonnes of highly toxic heptyl propellant.

Talgat Musabayev, head of Kazakhstan’s space agency Kazcosmos, said nitric oxide – a product of burning heptyl – was much less toxic for humans. He said it was raining in the area, so toxic clouds would probably not reach the town of Baikonur some 60 km away.

Whatever happened to kids' chemistry sets?

By Alex HudsonBBC News

http://www.bbc.co.uk/news/magazine-19050342

The first chemistry sets for children included dangerous substances like uranium dust and sodium cyanide, but all that has changed.

Talk to people of a certain age about chemistry sets and a nostalgic glaze comes over their eyes. Stories of creating explosions in garden sheds and burning holes in tables are told and childhood is remembered as a mischievous adventure.

Portable chemistry sets were first used in the 18th century but it took more than 100 years before they became popular with children, partly prompted by a desire to recreate the coloured puffs of smoke used by conjurors.

By the 1920s and 30s children had access to substances which would raise eyebrows in today's more safety-conscious times. Most will know cyanide as a deadly poison, but one of its main applications is in gold mining. It can make gold dissolve into water. Some chemistry sets of bygone ages even offered instructions and materials to be able to blow glass at high temperatures.

"You are letting a 12-year-old blow glass, there was uranium dust with a spinthariscope where you could see the radiation waves," says Rosie Cook, assistant curator at the Chemical Heritage Foundation. "By today's standards, they're terribly dangerous but they're fascinating nonetheless."

So what happened to the kits that were able to create the experiments that adults today so fondly remember? "Very often now, health and safety is used an excuse by schools, for example, not to do chemistry," says chemist Prof Martyn Poliakoff, of the University of Nottingham. "Not that it's dangerous necessarily but it's cheaper not to do the experiments."

Chemistry sets started a sales decline in the 1970s, both Al-Gailani and Cook note. By the 1980s they had lost their mainstream appeal. But is it really a case of health and safety gone mad?

In the 1950s, booklets offered lists of instructions like "how to make an explosive mixture". Now, even mildly explosive chemicals have been removed.

The decline in the sale of kids' chemistry set was mirrored by a shift away from science as a career. Parents instead pushed their children towards finance, the law and the like.

But sales of kits are increasing again. Internet retailer Discover This reported strong sales for chemistry sets and microscopes in 2011. It said that parents were looking for toys with an educational value.

At the same time, university application service Ucas has reported a 40% increase in the number of acceptances to chemistry courses at UK universities from 2003 to 2010.

And, with a little advice and supervision, the chemists of the future can play in relative safety.

"Don't lick it, don't eat it, don't sniff it, they are pretty good rules to live by in general," says Cook.

Etymology of Explosives

Online Etymology Dictionary

http://www.etymonline.com/index.php?term=explode

explode (v.)

1530s, "to reject with scorn," from Latin explodere "drive out or off by clapping, hiss off, hoot off," originally theatrical, "to drive an actor off the stage by making noise," hence "drive out, reject" (a sense surviving in an exploded theory), from ex- "out" (see ex-) + plaudere "to clap the hands, applaud," of uncertain origin. Athenian audiences were highly demonstrative. clapping and shouting approval, stamping, hissing, and hooting for disapproval. The Romans seem to have done likewise.

At the close of the performance of a comedy in the Roman theatre one of the actors dismissed the audience, with a request for their approbation, the expression being usually plaudite, vos plaudite, or vos valete et plaudite. [William Smith, "A First Latin Reading Book," 1890]

English used it to mean "drive out with violence and sudden noise" (1650s), later, "go off with a loud noise" (American English, 1790); sense of "to burst with destructive force" is first recorded 1882; of population, 1959. Related: Exploded; exploding.

http://www.etymonline.com/index.php?allowed_in_frame=0&search=explosive&searchmode=none

explosive (adj.)

1660s, "tending to explode," from Latin explos- (past participle stem of explodere; see explosion) + -ive.As a noun, from 1874.Related: Explosives.

primer (n.2)

"explosive cap," 1819, agent noun from prime (v.).

plosive (n.)

type of consonantal sound, 1899, from explosive. As an adjective from 1909.

propellant (n.)

less-etymological, but more usual, spelling of propellent; 1881 as a firearm explosive; 1919 as "fuel for a rocket engine."

mine (n.2)

explosive device, by 1850, from mine (v.2).

volcanic (adj.)

1774, from French volcanique (see volcano). Figurative sense of "prone to explosive activity" is attested from 1854.

big bang

hypothetical explosive beginning of the universe, developed from the work of Monsignor Georges Henri Joseph Édouard Lemaître and George Gamow, the name first attested 1950 (said to have been used orally 1949) by British astronomer Fred Hoyle (1915-2001) in an attempt to explain the idea in laymen's terms.

cordite (n.)

smokeless explosive, 1889, from cord + -ite (2); so called for its "curiously string-like appearance" in the words of a newspaper of the day.

warhead (n.)

1898, "explosive part of a torpedo," from war + head (n.).Later transferred to any missile (1944).

tamp (v.)

1819, "to fill (a hole containing an explosive) with dirt or clay before blasting," a workmen's word, perhaps a back-formation from tampion, that word being mistaken as a present participle (*tamping).

megaton (n.)

unit of explosive power equal to one million tons of TNT, 1952, from mega- + ton. Related: Megatonnage.

sputter (v.)

1590s, "to spit with explosive sounds," cognate with Dutch sputteren, West Frisian sputterje (see spout). Related: Sputtered; sputtering. The noun is attested from 1670s.

torpedo (n.)

1520s, "electric ray," from Latin torpedo, originally "numbness" (from the effect of being jolted by the ray's electric discharges), from torpere "be numb" (see torpor). The sense of "explosive device used to blow up enemy ships" is first recorded 1776, as a floating mine; the self-propelled version is from 1860s.

nitroglycerine (n.)

alsonitroglycerin, "explosive oily liquid," 1857, from nitro- + glycerin. So called either because it was obtained by treating glycerine with nitric and sulfuric acids or because it is essentially a nitrate (glyceryl trinitrate).

hand-grenade (n.)

1660s, from hand (n.) + grenade, which at that time referred to any explosive missile.

pop (n.1)

"a hit with an explosive sound," c.1400, of imitative origin. Meaning "flavored carbonated beverage" is from 1812.

A new manufactory of a nectar, between soda-water and ginger-beer, and called pop, because 'pop goes the cork' when it is drawn. [Southey, letter, 1812]

Sense of "ice cream on a stick" is from 1923 (see popsicle). Meaning "the (brief) time of a 'pop'" is from 1530s. Pop goes the weasel, a country dance, was popular 1850s in school yards, with organ grinders, at court balls, etc.

grenade (n.)

"small explosive shell," 1590s, earlier "pomegranate" (1520s), from Middle French grenade "pomegranate" (16c.), earlier grenate (12c.), from Old French pomegrenate (influenced by Spanish granada); so called because the many-seeded fruit suggested the powder-filled, fragmenting bomb, or from similarities of shape. See pomegranate.

cyber

as an element in word formation, ultimately from cybernetics (q.v.). It enjoyed explosive use with the rise of the Internet early 1990s. One researcher (Nagel) counted 104 words formed from it by 1994. Cyberpunk (by 1986) and cyberspace were among the earliest.

Cyber is such a perfect prefix. Because nobody has any idea what it means, it can be grafted onto any old word to make it seem new, cool -- and therefore strange, spooky. ["New York" magazine, Dec. 23, 1996].As a stand-alone, it is attested by 1998 as short for cybersex (which is attested by 1995).

fuse (n.)

"combustible cord or tube for lighting an explosive device," also fuze, 1640s, from Italian fuso "spindle" (so called because the originals were long, thin tubes filled with gunpowder), from Latin fusus "spindle," of uncertain origin. Influenced by French fusée "spindleful of hemp fiber," and obsolete English fusee "musket fired by a fuse." Meaning "device that breaks an electrical circuit" first recorded 1884, so named for its shape, but erroneously attributed to fuse (v.) because it melts.

plastic (adj.)

1630s, "capable of shaping or molding," from Latin plasticus, from Greek plastikos "able to be molded, pertaining to molding, fit for molding," also in reference to the arts, from plastos "molded, formed," verbal adjective from plassein "to mold" (see plasma). Surgical sense of "remedying a deficiency of structure" is first recorded 1839 (in plastic surgery). Meaning "made of plastic" is from 1909. Picked up in counterculture slang with meaning "false, superficial" (1963). Plastic explosive (n.) attested from 1894.

blow job (n.)

also blowjob, 1961, from blow + job. Exactly which blow is meant is the subject of some debate; the word might have begun as a euphemism for suck (thus from blow (v.1)), or it might refer to the explosive climax of an orgasm (thus blow (v.2)). Unlike much sex slang, its date of origin probably is pretty close to the date it first is attested in print: as recently as the early 1950s, military pilots could innocently talk of their jet planes as blow jobs according to the "Thesaurus of American Slang." Cf. blow (v.1).

bomb (n.)

1580s, from French bombe, from Italian bomba, probably from Latin bombus "a deep, hollow noise; a buzzing or booming sound," from Greek bombos "deep and hollow sound," echoic. Originally of mortar shells, etc.; modern sense of "explosive device placed by hand or dropped from airplane" is 1909. Meaning "old car" is from 1953. Meaning "success" is from 1954 (late 1990s slang the bomb "the best" is probably a fresh formation); opposite sense of "a failure" is from 1963. The bomb "atomic bomb" is from 1945.

bikini (n.)

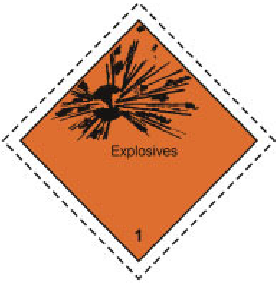
"low-waisted two-piece women's bathing suit," 1948, from French coinage, 1947, named for U.S. A-bomb test of June 1946 on Bikini, Marshall Islands atoll, locally Pikinni and said to derive from pik "surface" and ni "coconut," but this is uncertain. Various explanations for the swimsuit name have been suggested, none convincingly, the best being an analogy of the explosive force of the bomb and the impact of the bathing suit style on men's libidos (cf. c.1900 British slang assassin "an ornamental bow worn on the female breast," so called because it was very "killing").

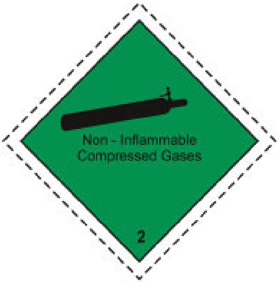
Bikini, ce mot cinglant comme l'explosion même ... correspondant au niveau du vêtement de plage à on anéantissement de la surface vêtue; à une minimisation extrême de la pudeur. [Le Monde, 1947]

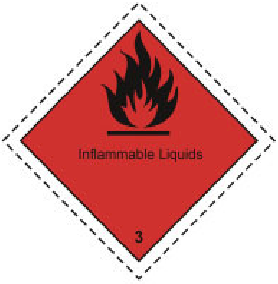
As a style of scanty briefs, from 1960. Variant trikini (1967), with separate bra cups held on by Velcro, falsely presumes a compound in bi-.

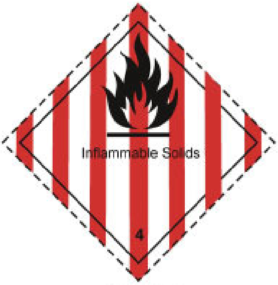
ПРИЛОЖЕНИЕ.
Аварийные сигналы и знаки опасности

Explosive and Chemical Safety

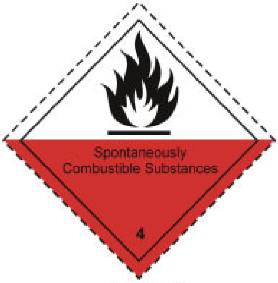




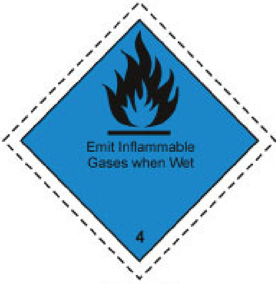




Division 4.1



Division 4.2


Emit Inflammable Gases when Wet
4

Division 4.3

Symbols for transport of dangerous goods by road. Based on the ‘ Transport of Dangerous Goods (Recommendations Prepared by the United Nations Committee of Experts on the Transport of Dangerous Goods)’, United Nations, New York, USA

Classes of Hazard Division

Class 1 Hazard Division (HD)

HD 1.1 Mass explosion and blast hazard.

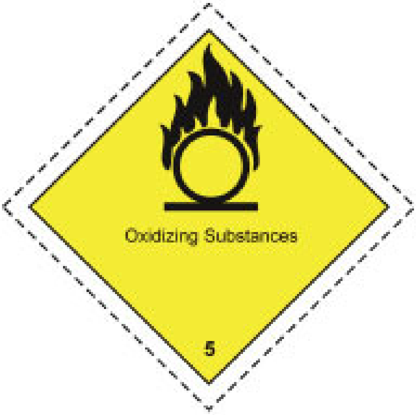
HD 1.2 Major projection hazard.

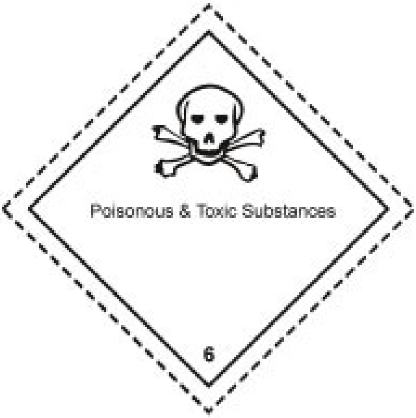
HD 1.3 Mass fire and heat radiation hazard.

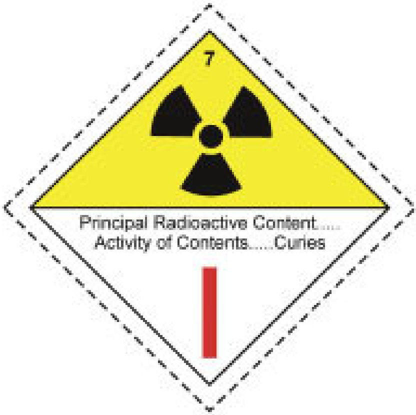
HD 1.4 Only moderate fire hazard.

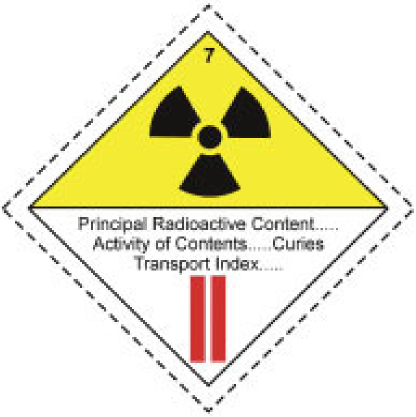
* * HD 1.5 Extremely insensitive detonating substances.

* * HD 1.6 Articles containing extremely insensitive detonating substances.


Oxidizing Substances
5


Poisonous & Toxic Substances
6


7
Principal Radioactive Content.....
Activity of Contents.....Curies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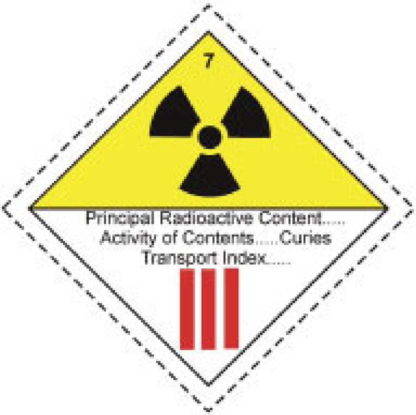
Principal Radioactive Content.....
Activity of Contents.....Curies
Transport Index.....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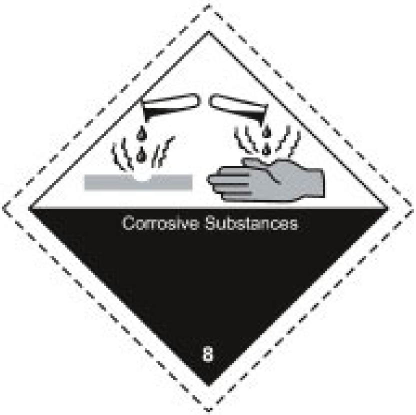
Principal Radioactive Content.....
Activity of Contents.....Curies
Transport Index.....


Corrosive Substances
8

Hazard Division 1.1 Comprises items which have a mass explosion hazard. The major hazards of this division are blast, high velocity projections and flame; the explosion results in severe structural damage, the severity and range being determined by the quantity of explosives involved. There may be a risk from heavy debris propelled from the structure in which the explosion occurs or from the crater.

Examples Initiators, high explosives, mines, 120 mm ammunition, HE shells.

Hazard Division 1.2 Comprises items which have a projection hazard with minor explosion effects but not a mass explosion hazard. Items burn and explode progressively, a few at a time. A considerable number of fragments, firebrands and unexploded items may be projected. Some of these may explode on impact and cause fire or explosion. Blast effects are limited to the immediate vicinity.

Examples 81 mm ammunition, 106 mm RCL, grenades

Hazard Division 1.3 Consists of items which have a mass fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard. Some items burn with great violence and intense heat, emitting considerable thermal radiation whereas others burn sporadically. They may form dangerous fragments. The firebrands and burning containers may be projected.

Examples Propellants and propellant charges.

Hazard Division 1.4 Consists of items which present no significant hazard and includes items which are primarily a moderate fire hazard. They do not contribute excessively to a fire. The effects are largely confined to the package. No fragments of appreciable size or range are expected. An external fire does not cause the simultaneous explosion of the total contents of a package of such items.

Examples Small arms ammunition, caps, fireworks.

Classes 4, 5 and 6 have been sub - divided:

Class 4 Inflammable solids, substances liable to spontaneous combustion, substances which on contact with water emit inflammable gases.

HD 4.1 Inflammable solids.

HD 4.2 Substances liable to spontaneous combustion.

HD 4.3 Substances which on contact with water emit inflammable gases.

Class 5 Oxidizing substances, organic peroxides

HD 5.1 Oxidizing substances.
HD 5.2 Organic peroxides.

Class 6 Poisonous (toxic) and infectious substances
HD 6.1 Poisonous (toxic) substances.
HD 6.2 Infectious substances.

Fire Divisions

To facilitate fire fighting, explosives and ammunition are divided into four Fire Divisions according to their behavior when involved in a fire and the action to be taken in dealing with such fires. The Fire Divisions are synonymous with the UN Hazard Divisions 1.1 to 1.4 and the hazard decreases with the ascending Fire Division, as described below:

1) **Fire Division 1:** These explosives are susceptible to explosion 'en masse'. The explosion may result in severe structural damage, the severity and range being determined by the quantity of high explosive involved. There may be a risk from heavy debris being propelled from the structure in which the explosion occurs. Possibility of a major hazard to the nearby surrounding area is also there due to the blast, flame and high speed fragments.

2) **Fire Division 2:** These explosives do not explode 'en masse' but have projection hazard and minor explosion effects. These may be exposed to fire for some time before exploding. Although the risk of mass explosion is not involved, small sporadic explosions may occur with increasing frequency as the fire takes hold. These burn and explode progressively a few at a time, coupled with a fragment hazard. A considerable number of small and large hot fragments, firebrands, unexploded and self - propelled items may be projected, some of these may explode on impact and propagate fire or explosion. Blast effects are limited. These explosions may give rise to toxic and corrosive hazard.

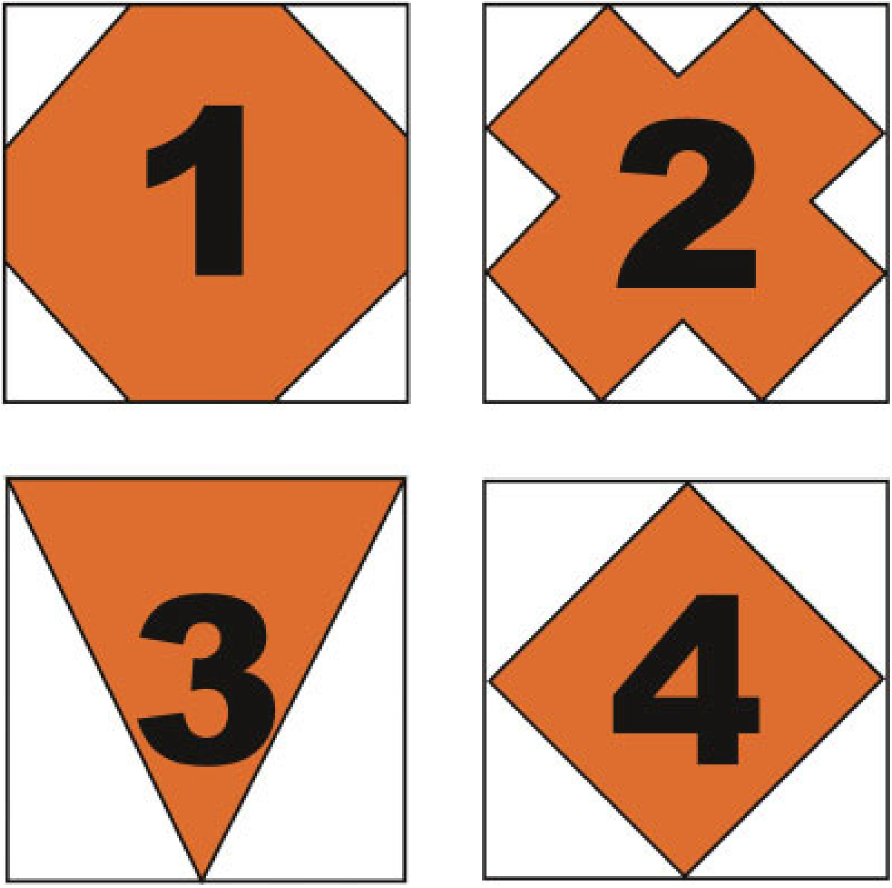
3) **Fire Division 3:** This Fire Division consists of low explosives, that is, solid and liquid propellants. When under fire, these explosives pose serious mass fire hazard with minor explosion or no explosion. These would not explode 'en masse'.

These are readily ignited and burn fiercely emitting intense heat and thermal radiation over a wide area but may or may not explode. These may give rise to dense smoke with toxic effects during burning, in some instances. These are entirely free from explosion. These items do not form dangerous fragments. Firebrands and burning containers may be thrown around.

4) **Fire Division 4:** These explosives present no significant explosion hazard but have a moderate fire hazard. The effects of fire are usually confined within the package. An external fire would not cause mass explosion of a package of such items. There could be toxic substances in them which may evolve toxic fumes on burning.

Each of the four fire divisions is indicated by a distinctive symbol in order to be recognized by fire - fighting personnel approaching a scene of fire. The color of all four symbols is ‘orange’ in accordance with the color code of UN for

Class 1 (Explosives and Ammunition) and the numbers are painted in black so that these symbols can be identified from a long range, the symbols differ in shape as follows.



Fire Division Shape
1 Octagon
2 Cross
3 Inverted Triangle
4 Diamond

Источники, использованные при написании учебного пособия

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УЧЕБНОЕ ИЗДАНИЕ

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HIGH ENERGY INTENSIVE MATERIALS
(Propellants, Explosives and Pyrotechnics)

PART I
EXPLOSIVES

Ответственный за выпуск и дизайн обложки Н.В.Кузнецова

Подписано в печать 6.05.2014 Формат 60х84 1/16
Бумага офсетная Печать Riso 7,67 усл. печ. л.
8,25 уч.- изд. л. Тираж 100 экз. Заказ «С» 56

Издательство Казанского национального исследовательского
технологического университета

Офсетная лаборатория Казанского национального
исследовательского технологического университета

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